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U.S. Department of Energy
Assistant Secretary for
Nuclear Energy
Deputy Assistant Secretary
for Nuclear Waste Management &
Fuel Cycle Programs

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Program Summary

Nuclear Waste Management & Fuel Cycle Programs

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U.S. Department of Energy
Assistant Secretary for
Nuclear Energy
Deputy Assistant Secretary
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Fuel Cycle Programs
Washington, DC. 20545

July 1982

Program Summary

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PREFACE

The Department of Energy's Commercial Waste Management and Fuel Cycle Programs' Summary Document outlines the operational and research and development activities which are essential to the safe isolation of the nation's commercially generated radioactive waste. It is primarily intended to describe DOE waste management and fuel cycle programs to Congress, the public, industry, and the research community. It focuses on the current and planned activities in waste management for FY 1982. We are currently investigating and evaluating alternatives to accelerate the schedule and work efforts to complete the geologic repository activities.

The reader is requested to offer comments and suggestions on this report and the work it describes. Such comments and suggestions and requests for any additional information should be directed to:

U.S. Department of Energy
Office of Nuclear Waste Management
and Fuel Cycle Programs
Mail Stop NE-310 (Germantown)
Washington, DC 20545

The six sections of the Summary Document consider the following elements sequentially: Policy and Budgetary Matters; Roles and Responsibilities; Commercial Waste Management; Nuclear Fuel Cycle; Remedial Action; and Program Management. Supplementary information is presented in a series of appendices.

F E Coffman

Franklin E. Coffman
Deputy Assistant Secretary
for Nuclear Waste Management
and Fuel Cycle Programs
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1.0 Introduction

This Program Summary Document describes the U.S. Department of Energy (DOE) Nuclear Waste Management and Fuel Cycle Programs. Particular emphasis is given to near-term, specifically Fiscal Year (FY) 1982, activities. The overall objective of these programs will be achieved by the demonstration of: (1) safe radioactive waste management practices for storage and disposal of high-level waste and (2) advanced technologies necessary to close the nuclear fuel cycle on a schedule which would assure a healthy future for the development of nuclear power in this country.

1.1 Policy Guidelines

President Reagan's statement of October 1981 (see Appendix A) provides the Administration's policies regarding nuclear power in this country. The highlights of this policy with respect to the DOE program for management of radioactive waste and the nuclear fuel cycle include:

- Pursuing consistent long-term policies concerning reprocessing of spent nuclear fuel and eliminating regulatory impediments to commercial interest in this technology, while ensuring adequate safeguards.
- Exercising the Federal responsibility for isolating and disposing of high-level radioactive waste without delay.
- Proceeding with the demonstration of breeder reactor technology including completion of the Clinch River Breeder Reactor.
- Participating in joint demonstration programs with utilities and the industry on activities leading to the licensing of alternative Light Water Reactor (LWR) spent fuel storage techniques.
- Supporting the States in their development of regional disposal sites for commercial low-level waste.
- Fostering a strong U.S. leadership role with continued bilateral and multilateral international agreements.

1.2 Program Target Dates and Budgets

The target dates for completing major government, and essential private sector activities, in the Nuclear Waste Management and Fuel Cycle Programs include the following:

Event	Date
Begin Commercial Light Water Reactor Reprocessing[1]	1989
Operate Clinch River Breeder Reactor Plant	1988
Begin Reprocessing of Liquid Metal Fast Breeder Reactor Fuel	1996
Submit Application for Repository License	1989
Operate an Unlicensed Test & Evaluation Facility	1989
Operate a Licensed Geologic Repository	1998
Operate New Commercial Low-Level Waste Burial Grounds[1]	Mid-1980's
Complete West Valley High-Level Waste Solidification	1991
Complete Remedial Action on Contaminated Sites:	
• Grand Junction	1986
• Uranium Mill Tailings at Inactive Sites	1989
• Formerly Used MED/AEC Sites	1992
• DOE Commercial Surplus Facilities	1992

[1] Private Sector Initiatives.

The budgets for the major program elements are shown in Table 1-1. Included in this summary table is the Nuclear Waste Disposal Fund.

Waste management legislation under consideration contains provisions which will require utility financing of this fund. In anticipation of passage of this legislation, the President's FY 1983 budget submission to the Congress contains provisions for the establishment of such a fund to finance terminal isolation project-specific activities. More specific information about the fund is presented later in this report.

1.3 Structure of this Document

In order to aid the reader of this document, the major subject areas and appropriate section numbers are given below.

Subject Area	Section
Roles and Responsibilities	2.0
Commercial Waste Management	3.0
Nuclear Fuel Cycle	4.0
Remedial Action Program	5.0
Program Management	6.0
President Reagan's Policy Statement	Appendix A
Program Participants and Budgets	Appendix B

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International Programs Appendix C
Definitions Appendix D
Acronyms Appendix E

Table 1-1
Program Summary Table
($ in Millions)

	FY 1981	FY 1982	FY 1983
Nuclear Waste Disposal Fund	$ 0	$ 0	$185.0
Commercial Waste Management			
Terminal Isolation	173.3	187.9	50.4
Waste Systems Technology	8.6	8.9	11.4
West Valley	5.0	9.9	15.4
Program Direction	1.9	2.6	3.3
Subtotal	188.8	209.3	80.5
Remedial Actions			
MED/AEC Sites	11.0	11.2	12.0
Grand Junction	2.0	1.7	1.8
Mill Tailings	13.2	18.2	23.2
Surplus Facilities	16.6	12.0	12.9
Program Direction	0.3	0.3	0.4
Subtotal	43.1	43.4	50.3
Nuclear Fuel Cycle			
Spent Fuel	20.0	6.8	6.9
Fuel Reprocessing	47.5	36.5	35.6
Waste Treatment	14.3	7.3	15.6
Program Direction	1.0	1.1	1.2
Subtotal	82.8	51.7	59.3
Total Program	$314.7	$304.4	$375.1

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2.0 Roles and Responsibilities

A number of public laws underlie the nuclear waste management and fuel cycle programs in the U.S. Table 2-1 presents a summary of selected Acts of Congress since the original authorizing legislation of 1954. Under these laws, DOE, as the lead agency, is authorized to plan and implement these programs. Other Federal Executive Offices and independent agencies are also assigned roles by the Congress; these are shown in Table 2-2.

Table 2-1
Summary of Relevant Public Laws

Acts	*Agencies With Principal Responsibilities*
Atomic Energy Act of 1954, as amended	Department of Energy Nuclear Regulatory Commission Environmental Protection Agency
Energy Reorganization Act of 1974	Department of Energy Nuclear Regulatory Commission
Department of Energy Organization Act of 1977	Department of Energy
Uranium Mill Tailings Radiation Control Act of 1978	Department of Energy Nuclear Regulatory Commission Department of the Interior (Bureau of Indian Affairs) Environmental Protection Agency
Hazardous Materials Transportation Act of 1975	Department of Transportation
Federal Water Pollution Control Act, as amended	Environmental Protection Agency
Marine Protection, Research, and Sanctuaries Act of 1972	Environmental Protection Agency Department of Transportation (U.S. Coast Guard)
Resource Conservation and Recovery Act of 1976	Environmental Protection Agency
Clean Air Act, as amended	Environmental Protection Agency
Act of 3 March 1849 (9 Stat. 395, 43 U.S.C. 1451)	Department of the Interior (Bureau of Indian Affairs)
Federal Land Policy and Management Act of 1976	Department of the Interior (Bureau of Land Management)
National Environmental Policy Act of 1969	Council on Environmental Quality
West Valley Demonstration Project Act of 1980	Department of Energy Nuclear Regulatory Commission
Low Level Radioactive Waste Policy Act of 1980	Department of Energy Nuclear Regulatory Commission

Table 2-2
Roles of Other Federal Entities

Department of State

— Helps to formulate policy on nonproliferation and to negotiate cooperative research with other nations.

Department of Labor

— Regulations set by OSHA to protect employees from (radioactive) occupational hazards at non-NRC regulated facilities involved in radioactive waste management operations.

Department of Commerce

— Conducts research in oceans and atmosphere related to radioactive waste management.

Department of Agriculture

— Analyze socioeconomic impacts of repository development in rural areas, and management of the National Forest System.

National Academy of Sciences*

— Maintains standing committee on Nuclear Waste Management to make recommendations on appropriate procedures.

Federal Emergency Managment Agency

— Assists in the development of emergency-response warning systems.

Office of Science and Technology Policy**

— Serves as a coordinator on scientific developments from many agencies involved in radioactive waste management.

Office of Management and Budget**

— For waste management program, serves to determine what can reasonably be achieved within the total Federal budget.

Office of Policy Development**

— Reviews radioactive waste management programs as primary advisor to the President.

*Not a Federal agency, but provides counsel to Federal agencies.
**Part of the Executive Office of the President.

This section presents an overview of the roles and responsibilities of the key Federal agencies involved in the Nuclear Waste Management and Fuel Cycle Programs. The role of Congress in reviewing, authorizing, and appropriating resources to implement these programs and developing legislation is discussed. Interactions among Federal agencies and cooperative efforts with State governments and Indian Tribes are discussed as well as National Environmental Policy Act (NEPA) compliance activities and public information objectives of these programs.

2.1 Roles and Responsibilities of Federal Agencies

Broad goals of ensuring the public welfare and national interests are expressed in various laws, with specific Federal agencies assigned responsibility and authority for implementation. This authority is translated into the formulation of programs and regulations by the appropriate agencies. The agencies which bear the major responsibilities for radioactive waste management are:

- Department of Energy
- Nuclear Regulatory Commission
- Environmental Protection Agency
- Department of Transportation
- Department of the Interior

The Executive Office of the President, which includes the Office of Management and Budget, the Office of Policy Development, the Office of Intergovernmental Affairs, the Office of Science and Technology Policy, and the Council on Environmental Quality, assists the President in exercising his broad responsibilities for overseeing and managing the Federal radioactive waste management program. Most importantly, the Office of Management and Budget has primary responsibility for working with departments and agencies to determine the budget for the radioactive waste management program that is submitted annually by the President to the Congress.

All of the agencies involved with radioactive waste management have developed programs which allow for public input in the decision-making process. These may be formal procedures, such as those required under the NEPA process, or informal activities, such as public information programs.

2.1.1 Department of Energy

The Department of Energy (DOE) is responsible for planning and carrying out programs for the safe handling of DOE-generated radioactive wastes, including any interim storage, processing, decontamination and decommissioning of facilities, and final disposal. DOE is also responsible for developing radioactive waste disposal technologies and for designing, constructing, and operating storage and disposal facilities for high-level and transuranic wastes, and nuclear fuel generated in the Federal government commercial programs. DOE has the lead role for: (1) coordinating all Federal non-regulatory aspects of radioactive waste management; (2) maintaining effective working relationships with regulatory bodies; and (3) developing strong and effective ties among the Federal government and the States and Indian Tribes on all aspects of radioactive waste management.

2.1.2 Nuclear Regulatory Commission

The Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 give the Nuclear Regulatory Commission (NRC) authority to license and regulate the possession and use of source, byproduct, and special nuclear material. However, these acts exempt DOE and its prime contractors from NRC licensing authority for the storage or disposal of radioactive wastes generated at DOE research and development facilities.

Under Section 274 of the 1954 Act, NRC may relinquish to States regulatory authority over byproduct, source, and special nuclear materials, in quantities not sufficient to form a critical mass, by entering into formal agreements. There are currently 26 such Agreement States. Pursuant to the individual agreements, these States may license commercial burial sites for low-level waste (at present all three of the operating commercial low-level burial sites are in Agreement States). These Agreement States also license uranium milling operations and decommissioned facilities located within their boundaries.

NRC is responsible for a regulatory framework which ensures public health and safety relative to high-level wastes, commercial low-level wastes, and radioactive wastes created in the milling of uranium ore. Specifically, NRC is responsible for licensing the receipt and possession of nuclear waste at: (1) all facilities primarily used for storage and/or disposal of high-level waste resulting from licensed activities; (2) facilities for long-term storage and/or disposal of DOE high-level waste; (3) facilities for interim storage and/or disposal of commercially generated spent nuclear fuel; (4) commercial low-level waste burial sites in non-Agreement States; (5) commercial disposal of special nuclear material in quantities sufficient to form a critical mass (in Agreement States and non-Agreement States); and (6) all commercial facilities for processing or treatment of radioactive waste. NRC licensing authority does not extend to: (1) DOE facilities not intended for long-term storage of DOE high-level wastes; (2) receipt or possession of radioactive wastes which are used for or are part of DOE research and development activities; or (3) DOE waste storage facilities in existence prior to enactment of the Energy Reorganization Act of 1974.

2.1.3 Environmental Protection Agency

The Environmental Protection Agency (EPA) is responsible for developing generally applicable environmental standards and Federal radiation protection guidance for radioactive materials. Compliance with these requirements is intended to ensure that waste management and disposal are consistent with the overall goal of protection of the health and safety of current and future generations. These standards are applicable to all categories of radioactive materials subject to regulation under the Atomic Energy Act of 1954. EPA is also responsible for the regulation of ocean disposal of radioactive material. Occupational radiation exposure of workers within the boundaries of a nuclear waste facility is controlled by DOE for its facilities and regulated by the NRC or States at other facilities.

2.1.4 Department of Transportation

The Department of Transportation (DOT) is responsible for developing, issuing, and enforcing safety standards governing certain packaging and shipping containers and for the labeling, classification, and marking of all waste packages for transit. These responsibilities are discharged in cooperation with NRC as delineated in a Memorandum of Understanding. DOT also implements safety standards for the mechanical condition of carrier equipment and qualifications of carrier personnel. DOT promulgated a final rule on highway routing in January 1981. The rule addresses routing issues raised by State, Tribal, and local bodies, such as use of interstate highways and pre-notification and emergency response considerations.

2.1.5 Department of the Interior

The Department of the Interior (DOI), through the U.S. Geological Survey (USGS), conducts laboratory and field geologic investigations in support of DOE's waste disposal programs, collaborates with DOE on earth sciences technical activities, and acts as a consultant to NRC, when NRC considers DOE applications for disposal facilities. The Bureau of Land Management (BLM), within DOI, is the custodian of certain Federal land holdings and reviews any proposal to place waste disposal facilities on such lands. DOI may authorize the administrative withdrawal of such public lands for limited use in support of radioactive waste disposal actions.

2.2 Congress

Congress establishes the laws under which radioactive waste management programs are conducted. These laws specify the legal authority for the Federal agencies to carry out their assigned missions, the clarification of agency vs. State roles in the decision process and in the conduct of the programs, and the legal authority for State responsibility concerning certain waste types. Through the annual budget process, the Congress reviews, authorizes, and appropriates the resources to carry out the programs. Congress must pass legislation for the permanent withdrawal of Federal lands for use as radioactive waste disposal locations. Under the Low-Level Radioactive Waste Policy Act (PL 96-573), Congress may approve or disapprove compacts between States regarding regional low-level waste (LLW) disposal sites. A number of committees in Congress have the responsibility for reviewing proposed legislation, messages, petitions, or other matters related to the various aspects of radioactive wastes and nuclear energy. The major Senate committees and their subcommittees include:

- Committee on Appropriations
  - Subcommittee on Energy and Water Development
- Committee on Energy and Natural Resources
  - Subcommittee on Research and Development
- Committee on Environment and Public Works
  - Subcommittee on Nuclear Regulation

In the House of Representatives the major committees and their subcommittees include:

- Committee on Appropriations
  - Subcommittee on Energy and Water Development
- Committee on Energy and Commerce
  - Subcommittee on Energy Conservation and Power
- Committee on Interior and Insular Affairs
  - Subcommittee on Energy and Environment
- Committee on Science and Technology
  - Subcommittee on Energy Research and Production

2.3 Federal Interaction

The coordination of actions among and within Federal agencies should provide for an integrated approach to minimize unnecessary duplication of effort and to ensure the programs are mutually supportive.

Formal mechanisms, for example, which are already in place, or are being developed include the following:

- Memoranda of Understanding (MOU) between agencies where their efforts may overlap or where the efforts of one agency are dependent upon or affect the efforts of another agency. The following MOU's are being developed or have been prepared:
  - DOE and DOI, regarding the support by USGS for repository siting research and development and on the BLM procedures to be followed for site investigations or administrative land withdrawal of public lands, where applicable.
  - NRC and DOE, on programmatic and technical information exchange that permits the agencies to coordinate their commercial high-level waste programs without compromising the Commission's ability to independently license and regulate future commercial high-level waste storage and/or disposal facilities.
- Preparation of an interagency cooperative development plan, to coordinate Federal agency programs in the area of radioactive waste management (e.g., Earth Sciences Technical Plan for the Geologic Repository Program).
- Procedural requirements, draft criteria, or standards proposed by one agency are subjected to review and comment by the public and affected agencies.
- Intergovernmental councils or committees established to coordinate the development of radiation protection policy.

2.4 Federal/State/Tribal Coordination

Commercial applications of nuclear technology can be found to some degree in every State in the form of electricity production and/or in the use of medical or industrial radioisotopes. The safe disposal of radioactive waste from such activities is a national concern and will involve the States, local governments, and Indian Tribes. There will be a need for a partnership, or at least a mutual understanding among the Federal government and the States and Indian Tribes. For regulatory functions, this understanding will evolve from the formal regulatory process.

For low-level waste, the Federal/State roles vary dependent upon sources of waste and Agreement States status. Both State and Federal activities will continue to be conducted in accordance with criteria and environmental practices which meet EPA standards. The Low-Level Radioactive Waste Policy Act of 1980 (PL 96-573) established the Federal policy that States are primarily responsible for disposing of low-level wastes generated within their boundaries. This law also established procedures for States to enter into regional compacts, subject to Congressional approvals.

Principal interaction will occur between the States and NRC, either as part of the NRC licensing and regulatory authority or in conjunction with the present partnership arrangement defined as part of the agreement. The State would regulate various activities to protect the public health and safety [Atomic Energy Act of 1954, as amended, Section 274(d)]:

(1) "The Governor of that State certifies that the State has a program for the control of radiation hazards adequate to protect the public health and safety with respect to the materials within the State ... and that the State desires to assume regulatory responsibility for such materials; and

(2) the Commission finds that the State program is compatible with the Commission's program for regulation of such materials, and that the State program is adequate to protect the public health and safety with respect to the materials covered by the proposed agreement."

For isolation in geologic repositories, the Federal government is committed to a principle of State consultation. This principle provides that a host State will have a continuing role in Federal decision-making on the siting, design, and construction of a high-level waste repository.

For uranium mill tailings, the Uranium Mill Tailings Radiation Control Act of 1978 (PL 95-604) defines the mechanism for the States to participate fully in the planning and implementation of the program, and provides a State/Federal sharing of remedial action costs at designated inactive uranium mill tailings sites. The Act also provides that Agreement States may assume the lead role in the management of active uranium processing sites within the standards set by EPA and the regulations established by NRC.

2.5 NEPA Compliance

The management of radioactive waste includes the preparation of environmental documentation as specified in the National Environmental Policy Act of 1969 (NEPA). These documents are prepared to aid Federal decision-makers by providing analyses of environmental, socioeconomic, and technical impacts of proposed agency actions. The NEPA process is designed to inform the public of the impacts of proposed Federal actions and to involve the public in agency decision-making. This process could involve: statement of no significant impact; environmental assessment; or environmental impact statement. Table 2-3 provides examples of NEPA-related activities related to the management of radioactive wastes.

2.6 Public Information

The objectives of public information programs in radioactive waste management are:

(1) To provide information to the public about waste management programs, technology, problems, and progress.

(2) To improve the quality of waste management decisions through solicitation of public input, analysis, and understanding of public concerns and issues.

(3) To achieve understanding of the decision-making process by having it open to public input from responsible parties, and by seeking advice from a diverse group of interests.

(4) To encourage public acceptance and cooperation in implementation of a technically sound waste management program that protects the health and safety of citizens and is compatible with broad social values. Better understanding of the problems and technology will lead to a more positive input from the public.

With its lead responsibility for research, development, and, in many cases, implementation of radioactive waste management technologies, DOE also has the primary responsibility for ensuring that the public is informed about and participates in decisions involving these activities. NRC, EPA, and DOT have responsibility for public participation in areas involving regulatory development, licensing, and enforcement. The States, Indian Tribes, and associations such as the National Governors' Association and the National Conference of State Legislatures also share responsibility for recommending improved procedures for Federal, State, local, and Tribal interaction, as well as wider public understanding and involvement in radioactive waste management decision-making.

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Table 2-3
NEPA Compliance Activities for Major Federal Agencies Regarding Radioactive Waste Management

Waste Program	*Activities Requiring NEPA Compliance*		
	DOE	*NRC*	*EPA*
West Valley	● Demonstration Project*	—	● Standards Development
Spent Nuclear Fuel	—	● Transshipment Approval ● Spent Fuel Storage Regulations ● Spent Fuel Storage Licensing	● Standards Development
Geologic Repositories	● National Plan for Siting High-Level Radioactive Waste Repositories* ● Detailed Site Studies ● TEF Facility Site Selection ● Site Recommendation/ Selection (and Land Protection) for Repository	● Procedural HLW Rules ● Technical HLW Rules ● Construction Authorization ● Operating License	● Standards Development
Low-Level Waste	—	● Establishment of LLW Regulations ● New Commercial Site Licensing ● Decommissioning	● Standards Development
Inactive Uranium Mill Tailings	● Select Remedial Action ● Select Disposal Site	— ● License Disposal Facilities	● Standards Development
Formerly Utilized Sites	● Select Remedial Action ● Select Disposal Site	● Develop Licensing Regulations ● License Disposal Facilities	● Standards Development
D&D Surplus Facilities	● Shippingport Atomic Power Station D&D*		

*Completed

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3.0 Commercial Waste Management

The following subsections provide an overview of the DOE Commercial Waste Management programs. The programs are subdivided into elements which parallel the 1983 budget request and include the following activities:

- Terminal isolation in a geologic respository
- Waste system technology
- West Valley demonstration project

The following sections are organized as follows: short background is given, followed by the overall strategy of the program; the immediate, near-term, and long-term objectives are listed; the major milestones of the program are outlined from 1982 to the completion of the projects; and budget appropriations or requests are given through FY 1983.

3.1 Terminal Isolation

The Terminal Isolation Program consists of generic research and development efforts and project-specific activities[2] leading to the site selection, design, licensing, construction and operation of high-level waste repositories.

Geologic repositories will be designed to accept solidified high-level waste (HLW) and transuranic (TRU) waste from commercial power reactors and from the Department of Energy (DOE) programs, and would also be capable of accepting unreprocessed spent fuel, if disposal of such materials were deemed appropriate.

The primary focus is on three geologic media (Hanford basalt, Nevada tuff, and bedded or dome salt) at specific sites to allow an early determination that these sites meet generalized standards and regulations compatible with those under development by EPA and NRC. Activities are also focused on the early construction of a Test and Evaluation Facility (TEF).

In addition, DOE will continue the long-term evaluation of diverse geologic media (granite and other rock types) to provide multiple candidates for sites in a regional system of repositories (See Figure 3-1).

3.1.1 Plan for Repository Development

An overview of the steps in the repository development effort is shown in Figure 3-2. In the early phases, the focus is on geologic screening, which involves characterization of surface and subsurface environments, leading to increasingly detailed studies of narrowed geographical and geologic areas until potential sites are identified. The information obtained during detailed characterization will assess a potential site's suitability and provide data required for the preparation of licensing documents.

Initial site protection measures will most likely be taken at the conclusion of the geographic screening phase when sites are selected for detailed site characterization. Because this characterization phase includes the sinking of exploratory shafts and in-situ testing, DOE will take steps to protect the land in order to ensure that other actions at or near the site do not render the site unsuitable for use as a repository. Protection of a site does not require full ownership rights to the property, but does require sufficient ownership interest (e.g., short-term lease acquisition or easement) to maintain the integrity of the site and have full access for characterization activities.

The detailed evaluation of a site will determine whether the site is qualified for licensing by comparing its characteristics against established criteria. If a site is determined to be suitable, then additional land protection measures (e.g., long-term lease acquisition) will be taken to supplement those taken previously to preserve the site for possible later selection as a repository location. On the other hand, if detailed site characterization finds that a site is not suitable, any land protection measures taken previously on the site would be terminated and the property returned to other uses.

Action to obtain full ownership of the site would not be initiated until after site selection. An EIS will be prepared as input into the decision to select a site for development of a repository. Under current plans, when three sites in two different geologic media have been characterized, one or more will be selected by DOE, and a construction authorization application will be submitted to NRC. Later in the process, licensing review, construction, and operation of the repository would take place.

The plan to develop the facilities to permanently dispose of radioactive wastes involves the coordinated and integrated efforts of several Federal agencies along with States, Indian Tribes and local governments. Figure 3-3 indicates that DOE and NRC will be the major participants and that DOI and EPA will play significant supporting roles. It also indicates that numerous activities of different types will be underway in parallel. Coordination between the participants is shown occurring early in the process and will continue throughout the repository development effort.

3.1.2 Regulation Development

The Energy Reorganization Act of 1974 sets forth NRC licensing authority for receipt and storage of HLW generated from NRC-licensed activities and for the long-term storage of HLW generated by DOE activities, except those related to research and development.

[2] Waste management legislation under consideration is described in Section 3.1.4.

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FIGURE 3-1
REGIONS UNDER CONSIDERATION FOR TERMINAL STORAGE OF NUCLEAR WASTE

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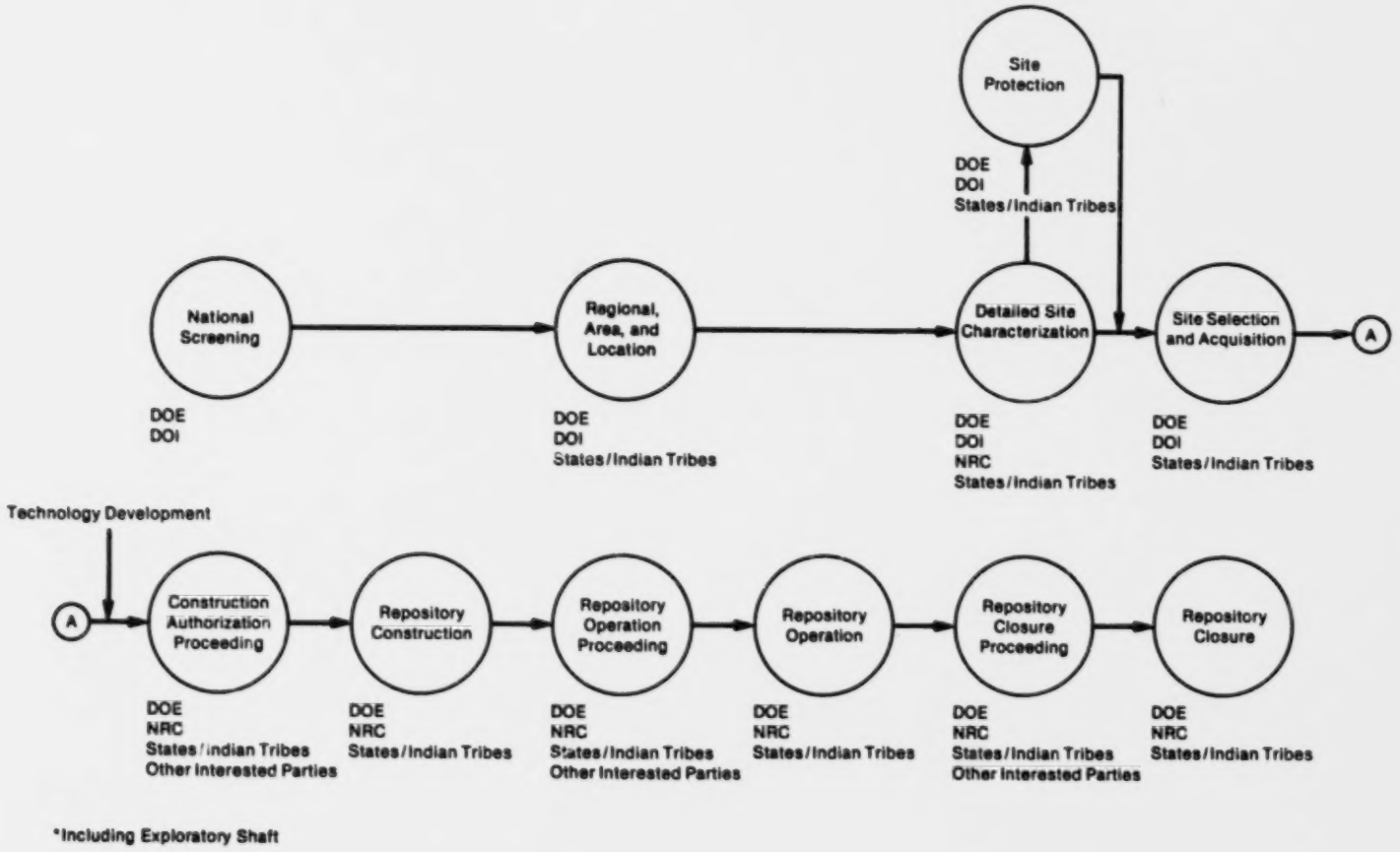

FIGURE 3-2
STEPS IN THE DEVELOPMENT OF A GEOLOGIC REPOSITORY

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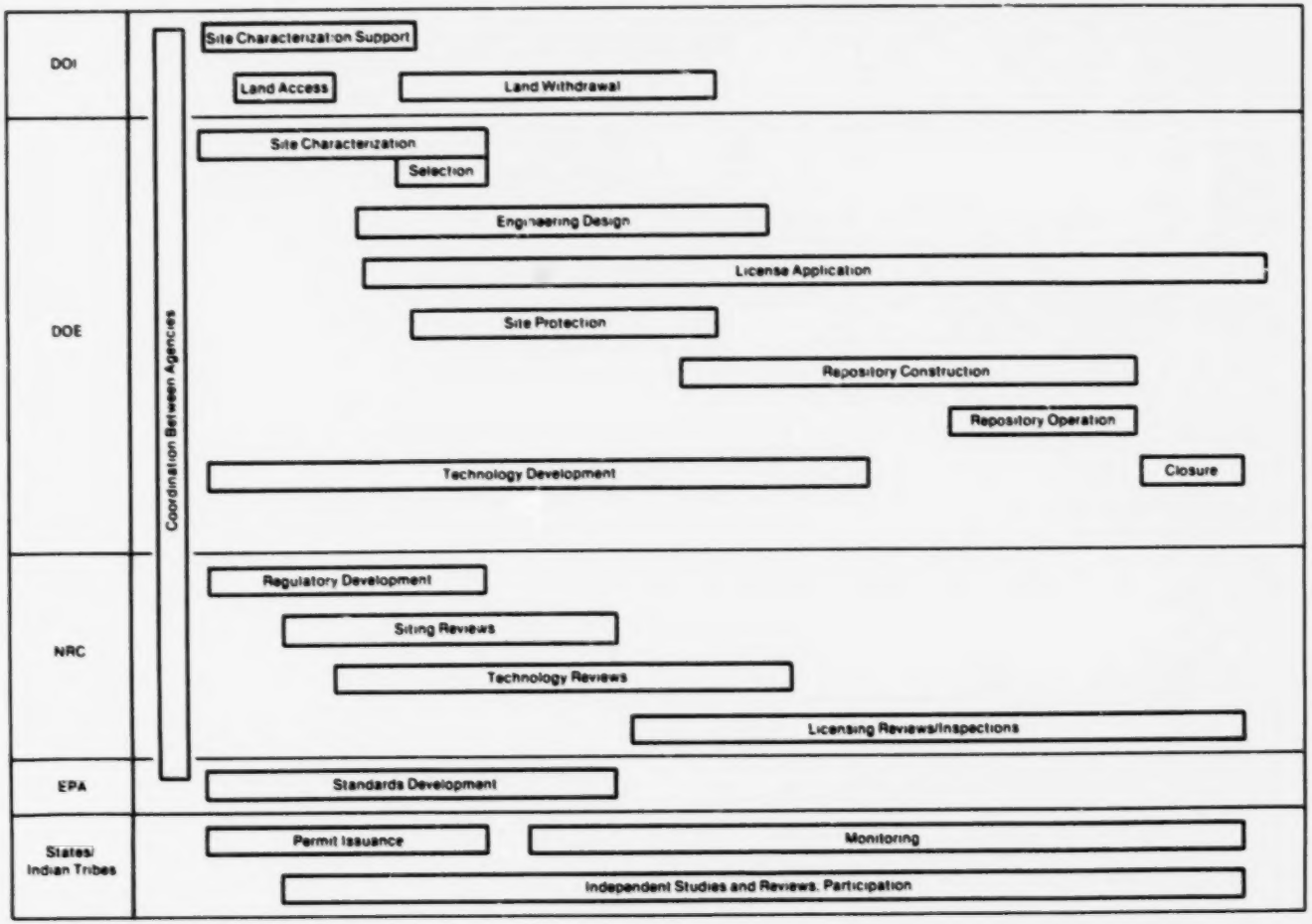

Note: The Activities Are Not Drawn to Reflect the Actual Time Scales Involved

FIGURE 3-3
RELATIONSHIP OF ACTIVITIES IN REPOSITORY DEVELOPMENT

Separate from this regulatory oversight by NRC, EPA is responsible for establishing generally applicable environmental standards for the management, storage, and disposal of HLW and TRU wastes. While EPA issued standards for the nuclear fuel cycle in 1977 (40 CFR 190), these standards explicitly excluded operations involving waste management. A specific standard for radioactive waste management is now under development by EPA and will be proposed in 1982. This standard will provide the fundamental basis for NRC's licensing activities and will determine the overall performance standard for the repository.

In the interim, DOE has developed broad objectives and criteria to guide its research and development programs. DOE's program, while guided by DOE objectives and criteria, has been designed to accomodate developing regulations and standards by the regulatory authorities.

The basic NRC regulations for geologic repositories are presented in 10 CFR 60. In the procedural portion of 10 CFR 60, which was published as a final rule on February 25, 1981, the NRC established a series of steps that DOE must complete to obtain authorization to dispose of HLW. Included in this series of actions is a site characterization report on each prospective site, request for construction authorization, application for a license to possess and dispose of HLW, and various amendments to the license, including the final one to close and decommission the repository. DOE is also required to provide periodic progress reports on the several site characterization studies and on construction and operation of the repository. On July 8, 1981, the sections of 10 CFR 60 covering technical requirements were published for comment as a proposed rule.

3.1.3 Waste Isolation System and Activities

The Terminal Isolation Program activities are those which are necessary to support repository design, licensing, construction, operation, and decommissioning. DOE subdivides the mined geologic disposal system into three major subsystems: the waste package, including the waste-bearing canister and associated overpacks and barriers; the repository, which consists of all man-made structures and components of the system including retarding backfills and seals; and the site, which consists of the host rock, the surrounding geologic formations, and the hydrogeologic environment.

The man-made or engineered barriers incorporated in the waste package and repository subsystems will provide containment of the waste, delaying the initiation of and retarding the rate of radionuclide release to the host rock. The host rock and the natural geologic and hydrologic features of the repository site, as well as the remoteness of the repository (in terms of depth below the surface and distance from water supplies), will provide natural barriers for isolating radioactive waste from people and their environment. To ensure compatibility and to enhance the effectiveness of the barriers, these subsystems are analyzed together as a system in the selection of the host rock and repository site, as well as in the design of the waste package and repository structure. Each of the components of the mined geologic disposal system is discussed below.

3.1.3.1 Waste Package.

The first of the major barriers to the release of radionuclides is the waste package. Its ability to provide containment will be based on a system of multiple engineered barriers that include a leach-resistant waste form, a high-integrity canister, buffers and radionuclide migration retardants, and an overpack that provides a long-term physical barrier.

Technical criteria proposed in the preliminary version of 10 CFR 60 require that the waste package contain the radionuclides for a period of at least 1000 years. The waste package program is directed toward developing the test methods for experimentally verifying the waste package system's performance, developing the models and calculational approach to predicting the long-term behavior of the package, and measuring the properties and performance characteristics of materials with which to construct the package.

3.1.3.2 Repository.

The second major component of the waste isolation system is the repository structure, which includes the surface and subsurface facilities designed to receive waste. While the subsurface portion of the repository is basically a system of drifts within the natural host rock, this component contributes to overall system performance by limiting adverse impacts of excavation and emplacement activities on the site by emplacing backfill and seals in the underground openings at the time of decommissioning.

The annual release of any radionuclide from the repository is required by 10 CFR 60 to be less than 1 part in 100,000 of the amount present at 1000 years after the repository is sealed. The EPA standard will provide a limit on the quantity of specified radionuclides released from the repository over a 10,000-year period. Also, the proposed 10 CFR 60 technical criteria require that the repository shall be designed with the capability to retrieve all the emplaced waste for up to 50 years after emplacement room backfill. The repository development program, along with the waste package program, is directed toward developing the methods and technology to meet these proposed regulatory requirements.

The repository structure must be designed to ensure that construction, emplacement of radioactive waste, and the effects of the waste will not compromise the natural integrity of the site. Also, the repository environment must be sufficiently defined to show that there are no interactions that will significantly compromise the performance of the waste package.

Current laboratory and field activities are providing the basis for future design and performance assessments of repository structures. Laboratory tests are performed to obtain leaching and retardation coefficients for various

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waste form and host rock combinations. Improvements in understanding the transport mechanisms and predictive capabilities will result from these studies.

Field testing is being conducted to provide the required technology data base for assessing the validity of analytical models, comparing in-situ and laboratory behavior, and confirming by demonstration the behavior of radioactive wastes emplaced in various geologic formations. Presently, there are a number of field-testing activities underway or planned in the various media; Table 3-1 is a summary of these activities.

Studies are being conducted to identify performance criteria for repository structures, and to identify equipment and instrumentation requirements for repository construction, operation, decommissioning, and monitoring. Because of the recognized importance of sealing the repository, borehole and shaft-sealing laboratory and field tests are also being performed.

3.1.3.3 Site.

The final major component of the waste isolation system is the site. The site will be selected to include natural barriers that provide containment and isolation by: (1) maintaining the waste in its emplaced condition for a given period of time; (2) limiting radionuclide mobility through the geohydrologic environment to the biosphere; and (3) assisting in keeping man away from the waste (i.e., minimizing intrusion to recover a valuable resource). The site will contain a host rock suitable for construction of the repository and containment of the waste, as well as surrounding rock formations which can provide adequate isolation. General repository site performance criteria are summarized in Table 3-2.

An Earth Science Technical Plan which identifies the basic scientific information necessary to evaluate the suitability of a site for location of a repository has been jointly developed by DOE and USGS and is being implemented. Methods for predicting the ability of potential sites to fulfill their function in isolation of the waste have been developed and are being refined and verified.

Several media, including salt, basalt, granite, and tuff, have been identified as having features that could make them acceptable as host media for geologic repositories. Evaluation of these media is being carried out by relating them to site performance criteria. These considerations are currently in various stages of the screening process. Emphasis in the near-term, leading to the first repository, is on basalt, tuff, and salt, while other media are being considered over the long-term.

Table 3-1
Repository Program Test Facilities

Medium	*Facility*	*Location*	*Scope*	*Period*	*Comments*
Salt Dome	Avery Island	Louisiana	● Thermomechanical ● Brine migration	1978 — 1980 1980 — 1981	Three heater tests
Granite	Stripa Mine (abandoned iron mine)	Sweden (U.S. participation)	● Geohydrology ● Thermomechanics ● Rock mechanics ● Fracturing/fracture hydrology	1978 — current	Heater tests, ventilation drift test
Granite	Climax	Nevada Test Site	● Thermomechanics ● Handling of spent Fuel; Radiation effects ● Radionuclide migration	1980 — 1985	Eleven canistered spent fuel assemblies, electric heaters, tracers and radioactive nuclides
Granite	Colorado School of Mines Experimental Mine	Colorado	● Effect of blasting on granite ● Thermomechanics	1979 — 1984	Block tests
Basalt	Near Surface Test Facility (NSTF)	Hanford	● Thermomechanics ● Rock mechanics	1980 — 1985	Heater and block tests
Tuff	G Tunnel	Nevada Test Site	● Thermomechanics ● Radionuclide migration	1980 — 1985	Tracers and radioactive nuclides

Source: Adapted from *Statement of Position of the U.S. Department of Energy: Waste Confidence Rulemaking, U.S. Nuclear Regulatory Commission.* DOE/NE-0007. U.S. Department of Energy. April 1980.

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Table 3-2
Site Performance Criteria

I. Site Geometry
- Minimum Depth
- Thickness
- Lateral Extent

II. Geohydrology
- Hydrological/ Geochemical Regime/Path Length/Travel Time
- Aquifer Flow/ Construction
- Dissolution of Rock
- Water Bodies/ Climatic Cycles

III. Geochemistry
- Chemical Interactions
- Radionuclide Retardation

IV. Geology
- Stratigraphy
- Host Rock Characteristics
- Virgin Rock Strength

V. Tectonic Environment
- Seismicity
- Quaternary Faults
- Quaternary Igneous Activity
- Uplift or Subsidence Rates
- Tectonic Elements

VI. Human Intrusion
- Resources
- Exploration History
- Ownership and Control

VII. Surface Characteristics
- Hydrological System
- Topographic Features
- Meteorological Phenomena
- Industrial/Transportation/Military Installations

VIII. Demography
- Transportation
- Urban Areas

IX. Environmental Protection
- Wilderness
- Rivers
- Wildlife
- National Parks
- Archaeology
- National Heritage
- Ambient Conditions

X. Socioeconomic Impacts
- Transportation Impacts
- Management of Impacts

Source: *NWTS Program Criteria for Mined Geologic Disposal of Nuclear Waste: Site Performance Criteria*. DOE/ NWTS-33(2), NWTS Program Office. U.S. Department of Energy. February 1981.

3.1.4 Nuclear Waste Disposal Fund

Waste management legislation under consideration requires utility financing of high-level waste disposal, establishes an Agency funding mechanism, and sets milestones for various phases of the Terminal Isolation Program. In the proposed FY 1983 authorizing legislation, the Administration is requesting that a fund known as the Nuclear Waste Disposal Fund be established to finance terminal isolation project-specific activities. Program activities that are not considered "project-specific" will continue to be funded by appropriations as in the past; these activities are described in the next section, "Generic R&D Funding". (Budget requests are summarized in Appendix B.).

Nuclear Waste Disposal Fund activities are directed toward the site selection, licensing, construction, and operation of mined geologic repositories and will include activities such as: site screening and characterization; surface and subsurface exploratory shaft construction; design and construction of the Test and Evaluation Facility (TEF); and directly related supporting technology, such as repcsitory and waste package designs, to assure the adequacy of project-specific activities. The broad resource base made possible by utility financing will ensure that needed funding is available to meet the critical milestones leading to the operations of a commercial repository.

3.1.5 Generic Research and Development Funding

Generic Research and Development efforts in the Terminal Isolation Program are those technology activities independent of geologic media that are necessary to support repository design, licensing, construction, operation, and decommissioning. These activities specifically include: generic performance assessment model development, waste disposal system analysis, spent fuel waste form characterization, waste package materials testing, generic geoscience methodology development, transportation planning and support to the Transportation Technology Center, regulatory interfaces, generic field testing (e.g., Climax, Stripa, Asse, etc.), and alternative disposal concepts. The study of subseabed disposal will continue to evaluate its role as a complement to mined geologic disposal and includes engineering studies of emplacement techniques, sediment thermomechanical studies, potential site assessment, in-situ heat transfer experimental testing, and safety assessment analysis. The subseabed program activities are focusing on the evaulation of the concept's technical and environmental feasibility. International assessment of the concept is coordinated through the Organization for Economic Cooperation and Development, Nuclear Energy Agency Seabed Working Group.

3.1.6 Schedule and Plan of Action

Elements involved in this program and their relationship are shown in Figure 3-4. As the figure shows, investigations are currently ongoing in basalt, tuff, and bedded and dome salt, leading toward the selection of three candidate sites for the TEF. Work at Hanford, the Nevada Test Site and in salt will proceed on exploratory shafts for underground investigations to confirm repository site suitability and provide input into the TEF siting decision. The TEF, which under the reference program is planned to be located at one of the three sites, will be part of a step-by-step program to gain experience with waste emplacement and to gain information for final decisions to construct full-scale facilities.

The TEF, the other two sites at which exploratory shafts have been completed, and continued long-term evaluation of diverse geologic media (granite and other rock types) will provide multiple candidates for sites in a regional system of repositories. The plan of action is presented below:

- Immediate attention is focused on:

  (1) Research and development, both in laboratories and at sites where underground workings can be

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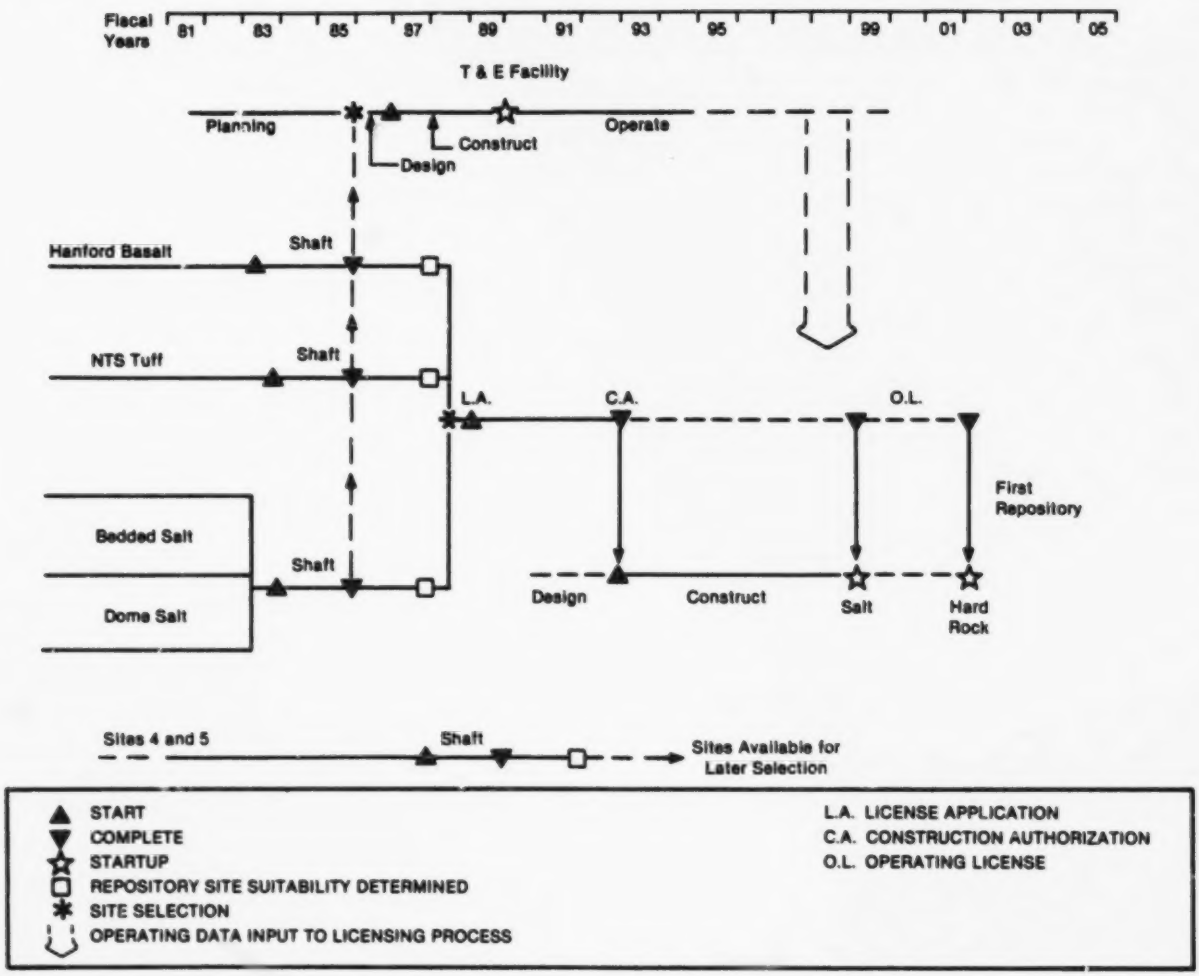

FIGURE 3-4
REFERENCE SCHEDULE OF ACTIVITIES LEADING TO GEOLOGIC REPOSITORY OPERATION

used to study the site, the repository, the waste package, and their interactions.

(2) Research and development on performance assessment to predict long-term system behavior.

(3) Site investigation activities at three specific locations for intensive study in different geologic media.

- Near-term activities will focus on:

  (1) Sinking exploratory shafts to repository depth and initiating detailed site studies at three candidate sites.

  (2) Developing an unlicensed Test and Evaluation Facility, currently planned to be located at one of the three candidate sites, with the emplacement of a few hundred canisters of waste in multiple-barrier, long-lived packages.

- Long-term activities will focus on:

  (1) Detailed investigations of other geologic formations, leading to identification of other potentially suitable repository sites in addition to the first three candidate sites.

  (2) Selecting one or more geologic environments for development of licensed repository(s).

- Following this approach, the following target dates are anticipated:

1982-1983	Review data from site exploration and drilling and begin exploratory shafts at three sites.
1985	Select location of the unlicensed Test and Evaluation Facility at one site, with construction to begin by 1986.

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1988	Submit to NRC an application for construction authorization for a licensed repository.
1989	The Test and Evaluation Facility becomes operational for the emplacement of a few hundred waste canisters.
1982-1991	Continued evaluation of alternative potential repository sites.
1992	Approval of license applications for construction authorization.
1998	Operation of the first full-scale licensed repository. DOE is currently studying potential strategies to accelerate this schedule.

Milestones and cost estimates are shown in Figure 3-5.

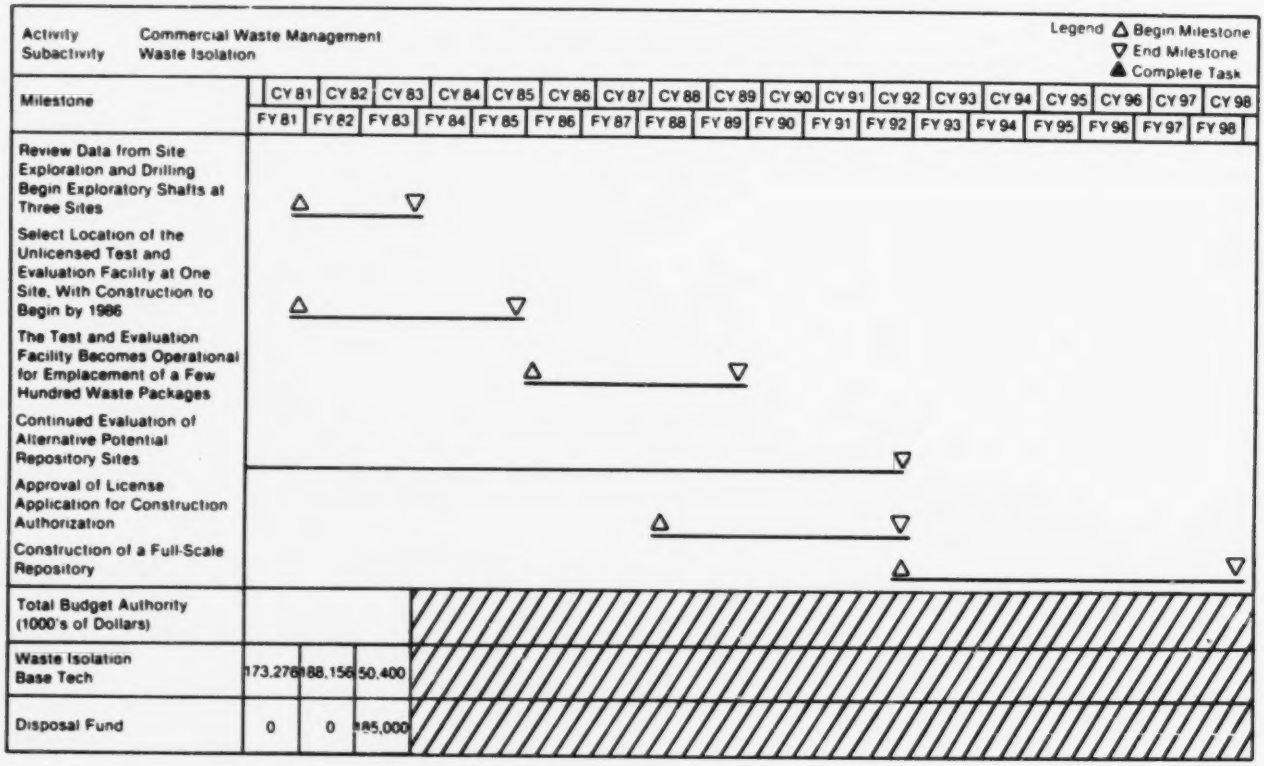
3.2 Waste System Technology

This program has three individual subprograms: Federal/State Interactions, Supporting Studies and Evaluations, and Low-Level Waste Technology. These subprograms share a common feature — that is the provision of Federal grants to States under cooperative agreements with those States, or a transfer of the technology developed by DOE to the States in a cooperative Federal/State program. Each of these subprograms is described below.

3.2.1 Federal/State Interactions

This subprogram provides funds to work with States to allow them to participate in the planning and implementation of the site qualification and selection program for mined geologic repositories. DOE is entering into cooperative agreements with States involved in the repository siting program to allow them full access to information, data and results gained from ongoing investigations. Under such an agreement, States are provided funds to support their review of data and findings from DOE investigations to facilitate the program activities. States affected by actual site characterization studies will receive grant funds, as appropriate, to conduct independent research on site-specific social and economic impacts to aid DOE in planning impact mitigation programs.

The development of procedures to initiate regional, area, and location studies in a State is particularly impor-


Activity Commercial Waste Management
Subactivity Waste Isolation
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▽ End Milestone
▲ Complete Task
Milestone
CY 81 CY 82 CY 83 CY 84 CY 85 CY 86 CY 87 CY 88 CY 89 CY 90 CY 91 CY 92 CY 93 CY 94 CY 95 CY 96 CY 97 CY 98
FY 81 FY 82 FY 83 FY 84 FY 85 FY 86 FY 87 FY 88 FY 89 FY 90 FY 91 FY 92 FY 93 FY 94 FY 95 FY 96 FY 97 FY 98
Review Data from Site Exploration and Drilling Begin Exploratory Shafts at Three Sites
Select Location of the Unlicensed Test and Evaluation Facility at One Site, With Construction to Begin by 1986
The Test and Evaluation Facility Becomes Operational for Emplacement of a Few Hundred Waste Packages
Continued Evaluation of Alternative Potential Repository Sites
Approval of License Application for Construction Authorization
Construction of a Full-Scale Repository
Total Budget Authority (1000's of Dollars)
Waste Isolation Base Tech
173,276
88,156
50,400
Disposal Fund
0
0
185,000

FIGURE 3-5
WASTE ISOLATION PROGRAM MILESTONES AND SCHEDULE

tant. While specific programs will vary, procedures to guide geologic and hydrologic studies will be established between DOE and a State or group of States. DOE will work with the State(s) to involve agencies and educational institutions in planning the field investigations and site characterization.

For site studies on non-DOE lands, the policy is to develop understandings with appropriate State officials prior to the initiation of physical investigations such as drilling. The conduct of literature survey-type site screening activities is preceded by notifications to appropriate State officials and designation of a State contact for coordinating such activities. Details of the consultation process may be established through formal or informal agreements developed between DOE and an individual State. Such agreements give the process stability over time, reinforce the commitments of involved parties, and provide flexibility to accommodate individual State concerns.

The mitigation of adverse socioeconomic impacts will involve judicious consideration of several larger issues such as public perceptions of risk, uncertainty, and the equitable distribution of these risks. The Federal policy regarding investigation of socioeconomic impacts is evolving and expanding to meet the problems discussed above. These efforts will be aided by Federal agencies, by public input, by the recently established National Academy of Sciences Panel on Socioeconomic Criteria in Siting, and by consultation with appropriate State and local governments.

3.2.2 Supporting Studies and Evaluations

This Supporting Study program includes three main areas of effort: international program support, special technical reviews by scientific groups, and independent assessment of programmatic and institutional issues. The thrust of these efforts is to assure adequate international cooperation, to provide an independent assessment of the technical adequacy of the program, and to evaluate potential alternatives which could improve the cost, schedule or technical aspects of the Commercial Waste Management programs.

The International program efforts in FY 1983 will provide the support required to meet the responsibilities for international, bilateral and multilateral programs.

Support of special technical reviews by the National Academy of Sciences will continue in FY 1983. Effort will also continue on independent assessment of technical and programmatic issues related to the integration and conduct of the Waste Management and Fuel Cycle activities. Sensitivity analysis of cost or schedule impacts of various alternatives will be conducted. General quality assurance support, socioeconomic analysis and environmental impact statement support will also be provided.

3.2.3 Commercial Low-Level Waste Program

Low-Level waste (LLW) is defined as radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel or byproduct material, as defined in Section 11e(2) of the Atomic Energy Act of 1954, as amended. LLW does not include waste from the mining and milling of uranium ores.

LLW[3] is produced in hospitals, research laboratories, universities, and in commercial and industrial applications including civilian nuclear power plants. The kinds of commercial LLW are quite varied, ranging from paper towels and laboratory gloves to liquids from various commercial processes and cleanup operations. Shallow land burial of commercial LLW is an established disposal practice. Figure 3.6 shows a typical LLW operation in progress. Commercial generators of LLW dispose of these wastes at commercial facilities licensed by the NRC or an Agreement State under Section 274 of the Atomic Energy Act of 1954, as amended.

NRC delegates to Agreement States the authority to regulate certain radioactive materials within their borders. All States, however, have the authority to regulate natural radioactive material that is not defined as source material (uranium or thorium). All States also have regulatory authority over artificially produced radioactive material (such as material produced by accelerators) that does not result from the production or use of special nuclear material.[4] The quantities of LLW generated in 1980 by commercial, industrial, and institutional sources in each of the 50 states and the District of Columbia are shown in Figure 3.7.

The locations of the six commercial LLW disposal sites that have operated since 1962 are also shown in Figure 3-7; three remain in operation as of March 1982. Additional regional commercial sites will be needed in the next few years (before 1990) as existing site capacity becomes exhausted or as restrictions limit what types of LLW the existing sites will accept.

In December 1980, the Low-Level Radioactive Waste Policy Act (PL 96-573) was enacted. This law gives States the responsibility to provide for disposal of the commercial LLW generated within their borders. This law also encourages the States to meet this new responsibility by forming regional groups and enacting compacts for which Congressional approval is required. Further, this law also provides that "after January 1, 1986, any such compact may restrict the use of the regional disposal facilities under the compact to the disposal of low-level radioactive waste generated within the region." Licensing of such sites would be under Agreement State provisions or by NRC in non-Agreement States.

Since the passage of this law, the States are actively and aggressively responding to this new responsibility. One regional compact has already been enacted in the Pacific Northwest, and several others are nearing completion. Almost all of the 50 States are involved in some activities related to forming regional compacts. Table 3-3 shows the status of those State planning efforts.

[3] LLW is also produced in DOE research operations. DOE and commercial LLW are comparable and are being handled similarly.

[4] Special nuclear material includes plutonium, uranium-233, uranium enriched to any degree in uranium-235, or any other source material so determined by NRC.

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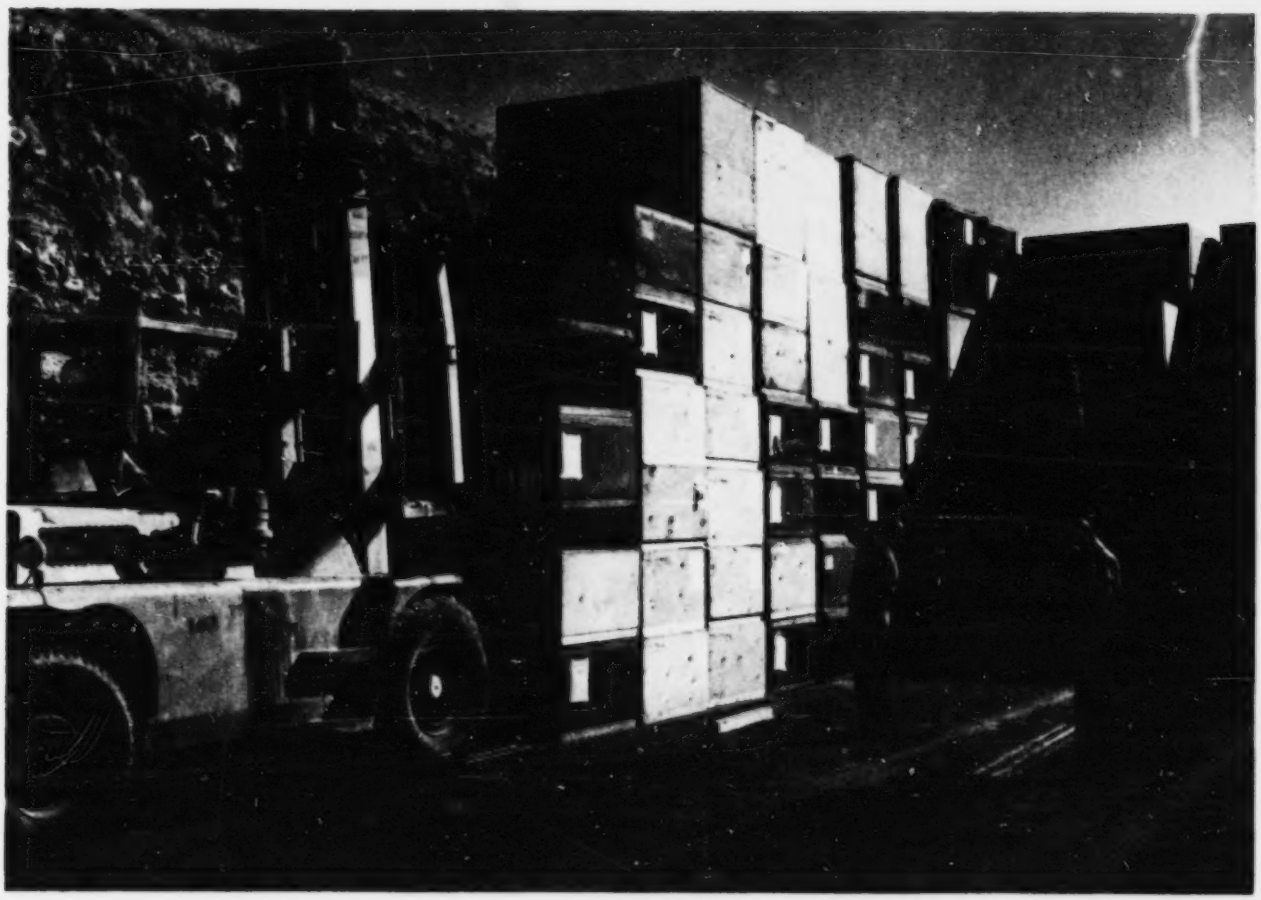

FIGURE 3-8
OFF LOADING LOW-LEVEL WASTE

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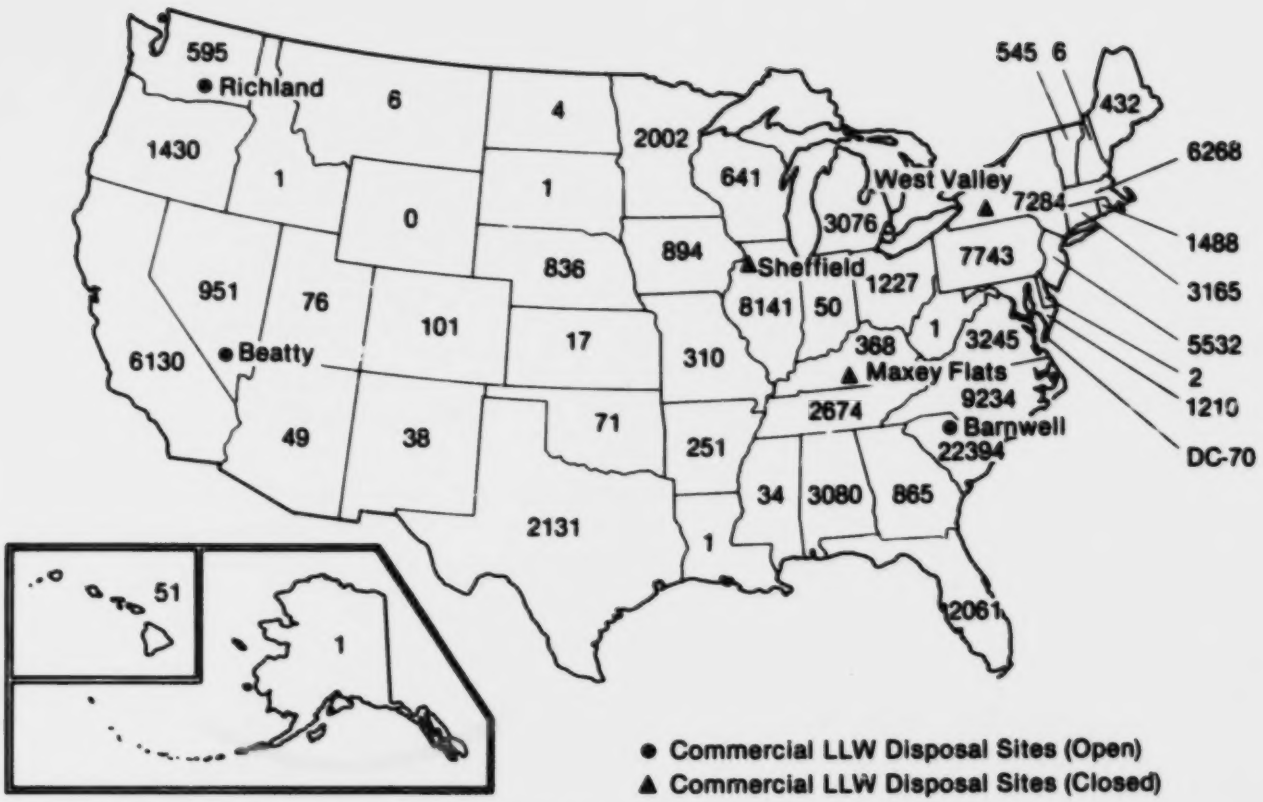

Quantities of Commercial Low-Level Wastes Generated in Each State in 1980 and Buried at Commercial Disposal Sites. (Volumes in Cubic Meters)

FIGURE 3-7
QUANTITIES OF LLW PRODUCED BY STATES IN 1980

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Table 3-3
Status of Potential Party States of Low-Level Radioactive Waste Interstate Compacts
(March 1, 1982)

Northwest	*Rocky Mountain*	*Central*	*Midwest*	*Southwest*	*Mid-Atlantic*	*Northeast*	*(Going Alone)*	*(Unaffiliated)*
Alaska	Arizona	Arkansas	Delaware*	Alabama	Delaware*	Connecticut	Texas	California
Hawaii	Colorado	Iowa*	Illinois	Florida	District of Columbia	Maine		Puerto Rico
Idaho	Nevada	Kansas*	Indiana	Georgia	Kentucky*	Massachusetts		Virgin Islands
Montana	New Mexico	Louisiana	Iowa*	Mississippi	Maryland*	New Hampshire		Guam
Oregon	Utah*	Minnesota*	Kentucky*	North Carolina*	North Carolina*	New Jersey		Northern Mariana Islands
Utah*	Wyoming	Missouri*	Kansas*	South Carolina	Virginia*	New York		Trust Territory of the Pacific Islands
Washington		Nebraska*	Maryland*	Tennessee	West Virginia	Pennsylvania		
Wyoming*		North Dakota*	Michigan			Rhode Island		
		Oklahoma	Minnesota*			Vermont		
			Missouri*					
			Nebraska*					
			North Dakota*					
			Ohio					
			South Dakota*					
			Virginia*					
			Wisconsin					

*States potentially belonging to more than one compact.

Source: NRC Office of State Programs.

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Elements involved in the management of the Commercial Low-Level Waste Program, and their relationships are graphically displayed in Figure 3.8. The essence of this strategy is the following. The Federal government will continue to provide technical, financial, and regulatory assistance to the States as authorized by the Congress. EPA's environmental standards for LLW and NRC's regulations will provide guidance to the States for site selection, site suitability, disposal practices, and acceptable waste forms for disposal. DOE is developing and encouraging the use of new technologies for volume reduction, packaging, and disposal, and will continue to provide technical assistance to the States as part of the LLW program. Milestones and budget needs are shown in Figure 3.9.

The plan of action for the management of commercial LLW is given below:

- Immediate attention is focused on:
  - (1) Continuing current practices of LLW burial at commercial sites and implementing improvements as necessary.
  - (2) Developing geohydrologic and demographic guidelines for commercial screening and site selection.
  - (3) Research and technology development for volume reduction, waste treatment and improved disposal methods.
  - (4) Assisting in the establishment of multi-State compacts for the development and operation of regional commercial waste management facilities.
- Near-term activities will focus on:
  - (1) Providing technical support to States and regions, up to the point of disposal site selection.
  - (2) Research, development, demonstration, and technology transfer for advances in waste treatment and processing, volume reduction, and waste disposal methods.
  - (3) Providing support to States in the development and operation of regional compacts.
- Long-term activities will focus on:
  - (1) Providing support to the States and regions for development of improved approaches to the management of LLW.
  - (2) Continuing technology development for waste reduction and disposal.

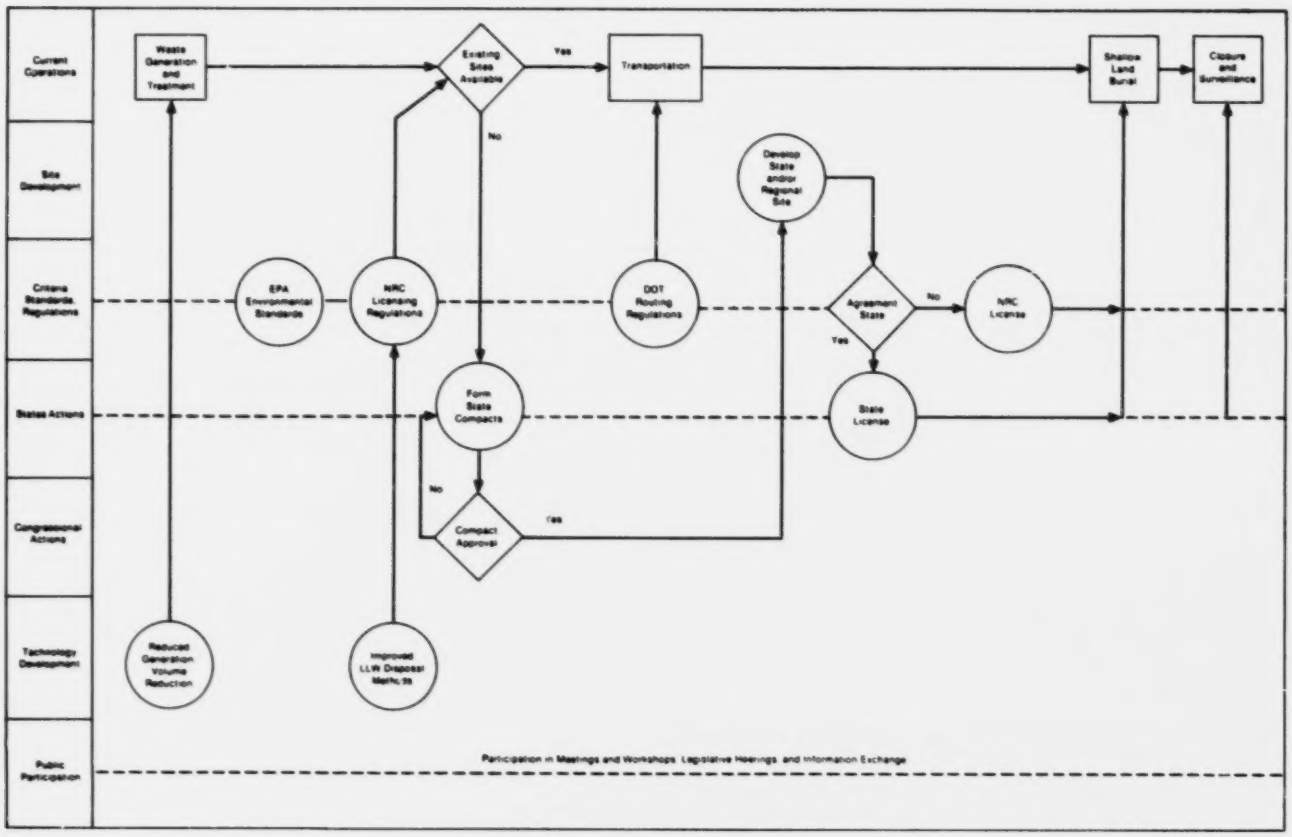

FIGURE 3-8
STRATEGY FOR COMMERCIAL LLW

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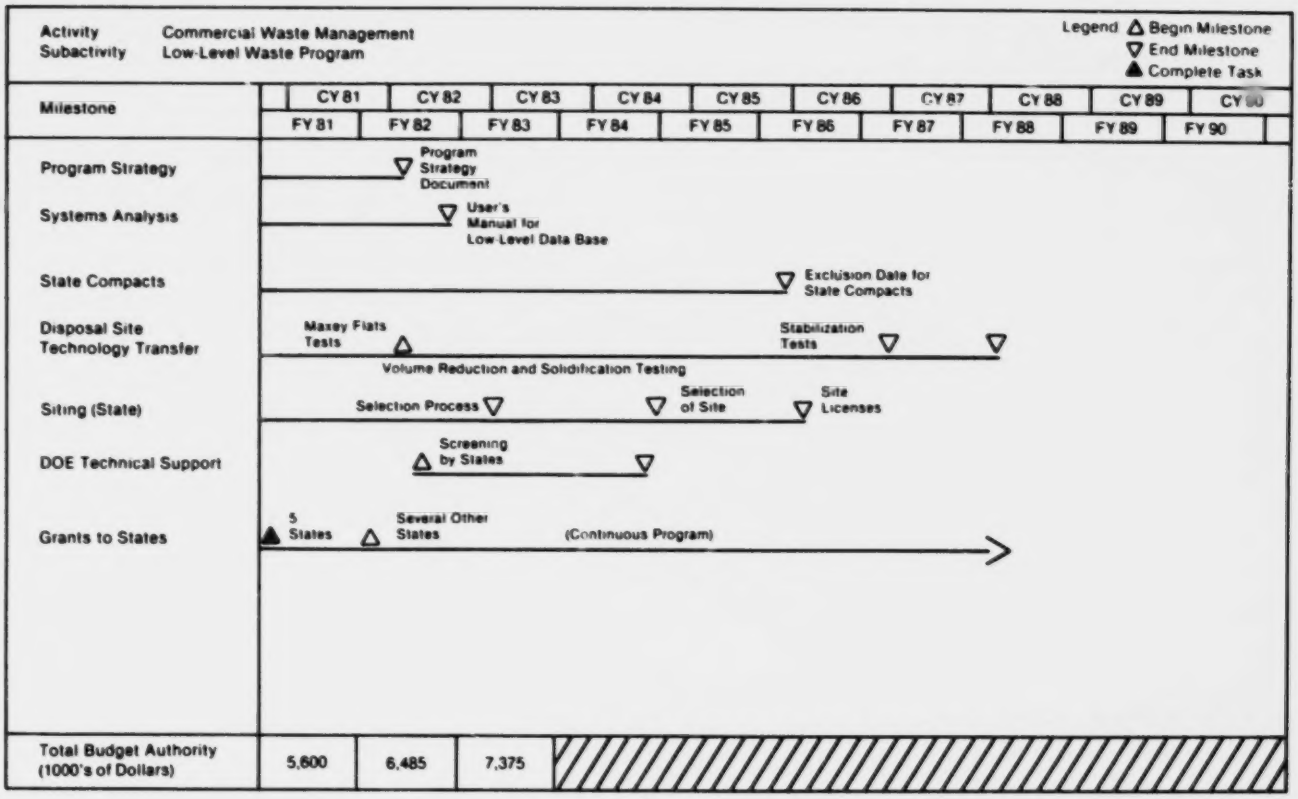
Activity Commercial Waste Management
Subactivity Low-Level Waste Program
Legend △ Begin Milestone
▽ End Milestone
▲ Complete Task
Milestone
CY 81 CY 82 CY 83 CY 84 CY 85 CY 86 CY 87 CY 88 CY 89 CY 90
FY 81 FY 82 FY 83 FY 84 FY 85 FY 86 FY 87 FY 88 FY 89 FY 90
Program Strategy
Program Strategy Document
Systems Analysis
User's Manual for Low-Level Data Base
State Compacts
Exclusion Date for State Compacts
Disposal Site Technology Transfer
Maxey Flats Tests
Stabilization Tests
Volume Reduction and Solidification Testing
Siting (State)
Selection Process
Selection of Site
Site Licenses
DOE Technical Support
Screening by States
Grants to States
5 States
Several Other States
(Continuous Program)
Total Budget Authority (1000's of Dollars)
5,600
6,485
7,375

FIGURE 3-9
COMMERCIAL LLW PROGRAM MILESTONES AND SCHEDULE

- Following this approach, the following target dates are anticipated:

1982	Provide stragety for State assistance program, including technology transfer, a systems model, and updated data base; begin Maxey Flats tests on technology transfer; provide grants to selected States.
1983	Continue technical program on waste form, volume reduction, waste migration, and site stabilization to eventually transfer technology to commercial sector.
1982-1984	Provide assistance to States in the area of site screening and selection methodologies; demonstrate improved technologies.
1986	Exclusion deadline for State and regional compacts; complete technology transfer for volume reduction and stabilization; continue State assistance as necessary.
1988	Complete all technology transfer including solidification testing.

3.3 West Valley Program

Only one commercial venture to reprocess reactor spent fuels has been licensed in the United States. That plant, located near West Valley in western New York, operated from 1966 through 1972. The general location of the West Valley site is shown on Figure 3-10. High-level waste (HLW)[5] from reprocessing about 650 tonnes of spent fuel is stored in tanks located in underground reinforced concrete vaults. HLW has not been produced at this site since operations were suspended in 1972. There are about 600,000 gallons including about 560,000 gallons from Purex processing which have been neutralized by addition of sodium hydroxide and about 12,000 gallons of acidic waste from Thorex processing. In 1976, the plant licensee decided to terminate operations at the facility.

[5] High-level waste results from the chemical processing of nuclear reactor fuels. It is separated in the form of a radioactive, acidic liquid during the steps to extract and purify plutonium and uranium from irradiated fuel. It contains most of the fission products from the spent fuel, and the actinides which were not separated out during processing. Only about 5 percent of the weight (excluding water) of HLW is radioactive, the remainder being non-radioactive materials added during processing.

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FIGURE 3-10
LOCATION OF THE WESTERN NEW YORK NUCLEAR CENTER, WEST VALLEY, NEW YORK

The responsibility for the wastes, by contract, reverted to the State of New York when the plant licensee's lease on the site expired in 1980. However, the West Valley Demonstration Project Act of 1980 (PL 96-368), enacted in October 1980, has transferred to DOE the responsibility for immobilization of HLW at West Valley.

Specifically, the Act provides that DOE carry out a demonstration of solidification techniques which can be used to prepare HLW for disposal and directs DOE to:

- Solidify HLW at West Valley in a form suitable for transport and disposal.
- Develop containers suitable for permanent disposal of solidified HLW.
- Transport the solidified HLW to a Federal repository as soon as feasible.

The Act also requires DOE to dispose of any low-level and transuranic wastes which might be produced as a consequence of the solidification of HLW and to decontaminate and decommission the HLW storage tanks and other hardware and facilities used in connection with the demonstration project.

Although the West Valley reprocessing facilities shown on Figure 3-11 were licensed by the NRC, the demonstration project is not subject to NRC regulation or licensing. On September 30, 1981, the NRC approved transfer of operating responsibility for the facilities to DOE for the duration of the demonstration project. On February 25, 1982, DOE assumed responsibility for site operations from the commercial operator and the State. However, the Act requires that DOE and NRC establish an arrangement for Commission review and consultation with respect to the

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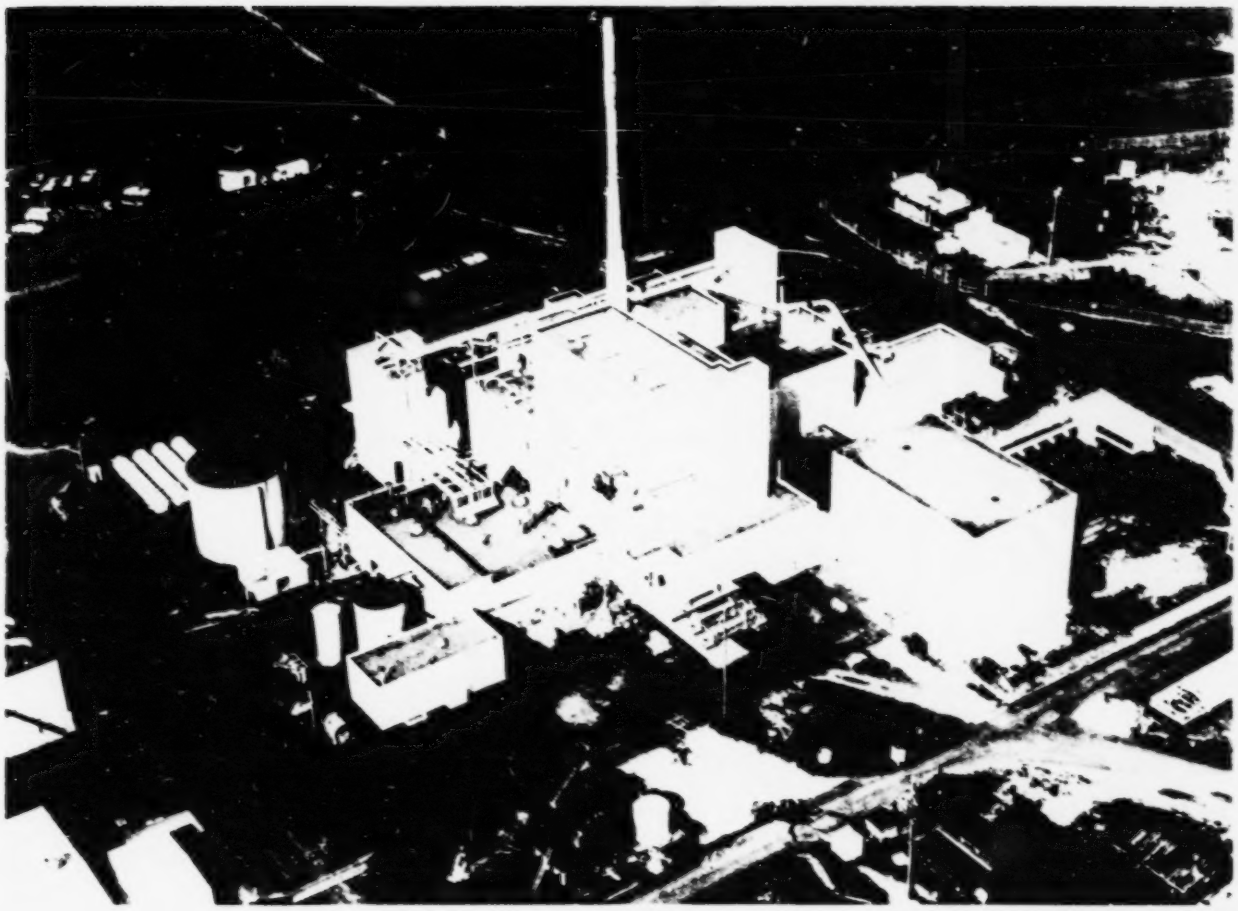

FIGURE 3-11
AERIAL VIEW OF THE WEST VALLEY FACILITY: SITE OF THE DEMONSTRATION PROJECT

project. It also requires that DOE consult with the NRC on removal and solidification of the waste, selection of waste form and containers, preparation of the waste for disposal, and decontamination and decommissioning (D&D) of the facilities. This review and consultation does not require formal procedures or actions by the NRC. DOE and the NRC defined their working relationship in a Memorandum of Understanding approved on September 23, 1981. Other aspects of the West Valley facilities which are not related to the demonstration project, such as the operation of the State-licensed low-level waste burial grounds, are strictly a State responsiblity and do not involve DOE. NRC may have regulatory involvement over these other aspects on a case-by-case basis.

The Act also requires DOE and the State of New York to enter into a cooperative agreement for performance of the project. The agreement was signed on November 3, 1980 and amended on September 16, 1981. Under the terms of the Act and cooperative agreement, the State makes available to DOE the facilities and the HLW necessary for the completion of the demonstration without transfer of title. Additionally, the Federal Government (DOE) will pay 90 percent of the costs and the State of New York 10 percent. The agreement also provides for the State to play a role in the project management and decision making process.

It is important to note that the Act does not authorize the Federal government to acquire title to the HLW or to any of the existing facilities at the site. Responsibility for the site still will rest with the State.

3.3.1 West Valley Management Plan

The basic plan for the management of HLW at West Valley includes:

- Product and process technology development
- Facility construction and operation

Because of the similarity of the West Valley HLW to those at Savannah River, the plans for West Valley depend

heavily upon the technology for waste removal, solidification, and containerization being developed for Savannah River. In addition, the program will draw heavily upon the technological expertise being developed for the commercial and defense high-level waste management programs in general.

In 1980, an ad hoc panel of DOE and contractor personnel was convened to evaluate waste forms which might be applicable to the West Valley wastes. Its conclusion was that borosilicate glass would be a suitable preliminary selection; however, the final decision on waste form would be made by 1984 in order to use the latest available information. Based on the borosilicate glass technology, the Battelle Pacific Northwest Laboratory has prepared a preconceptual design study. This study showed, based upon existing solidification technology and designs, that a three-year processing campaign starting in 1987 would be feasible for processing all the West Valley HLW. Such a process would produce 240 to 300 canisters (2-ft diameter by 10-ft length) of immobilized waste.

In December 1979, DOE, with the assistance of Argonne National Laboratory, began preparation of an EIS for the demonstration program. The public was invited to participate in determining the appropriate scope of the statement, including the range of actions, alternatives, and impacts to be included. Written comments were solicited in a Federal Register notice of December 12, 1979, and through direct mailings. A public scoping meeting was conducted on February 2, 1980.

The Draft EIS was completed July 31, 1981, and was issued for public review and comment. Public hearings were held on September 26, 1981. Written comments and oral statements received are being considered in preparing the Final EIS, the publication of which is planned for July 1982. The decision on waste form will be supported by a supplemental environmental review.

Transportation to an off-site Federal repository of immobilized HLW is essential for permanent isolation. Safe transport will be ensured by accident-resistant packaging and shipment in accordance with applicable provisions of law. The shipping containers must be able to survive severe real and hypothetical accident conditions and demonstrate resistance to impact, puncture, fire, and submersion in water. The ability of the transportation package to survive must be demonstrated by testing or analysis.

Elements involved in the management of HLW at West Valley including those relating to the development of a licensed mined geologic repository,[6] and their relationships are graphically displayed in Figure 3.12.

3.3.2 Plan of Action

A summary of the plan for the demonstration project is presented below.

- Immediate attention is focused on:
  - (1) Selecting contractors[7] for the implementation of the elements described in West Valley legislation.
  - (2) Preparing a comprehensive design for waste removal and processing based upon existing solidification technology.
  - (3) Developing techniques to obtain samples of HLW for chemical, physical, and radiological analysis.
  - (4) Coordinating and interfacing with the waste solidification, package, transportation, and disposal programs.
- Near-term activities will focus on:
  - (1) Selecting a suitable solid waste form for the processing facility.
  - (2) Developing methods for retrieval of HLW from storage facilities.
  - (3) Identifying, designing, and constructing the necessary systems and facilities for solidifying the waste.
- Long-term activities will focus on:
  - (1) Removal of HLW and conversion to a waste form suitable for transportation and repository emplacement.
  - (2) Storage or removal of immobilized HLW to an off-site repository.
  - (3) Decontamination and decommissioning of HLW solidification facilities and storage tanks.
- Following this approach the following target dates are anticipated:

1982	Site takeover; Complete R&D on alternatives; Select a waste form and process for engineering development.
1983	Complete solidification plan; Begin modifications and onsite decontamination to prepare existing facilities for use.
1986	Complete design engineering plans.
1988	Complete waste processing facility construction and start soldification.
1988-1991	Solidification of waste and transport to Federal facility.
1991-1994	Complete final phases of project D&D.

Milestones and cost estimates for the activities at West Valley are shown in Figure 3.13.

[6] More details on this program are presented in Section 3.1 of this report.

[7] The site operating contractor is the West Valley Nuclear Services Company, Inc., a subsidiary of the Westinghouse Electric Corporation.

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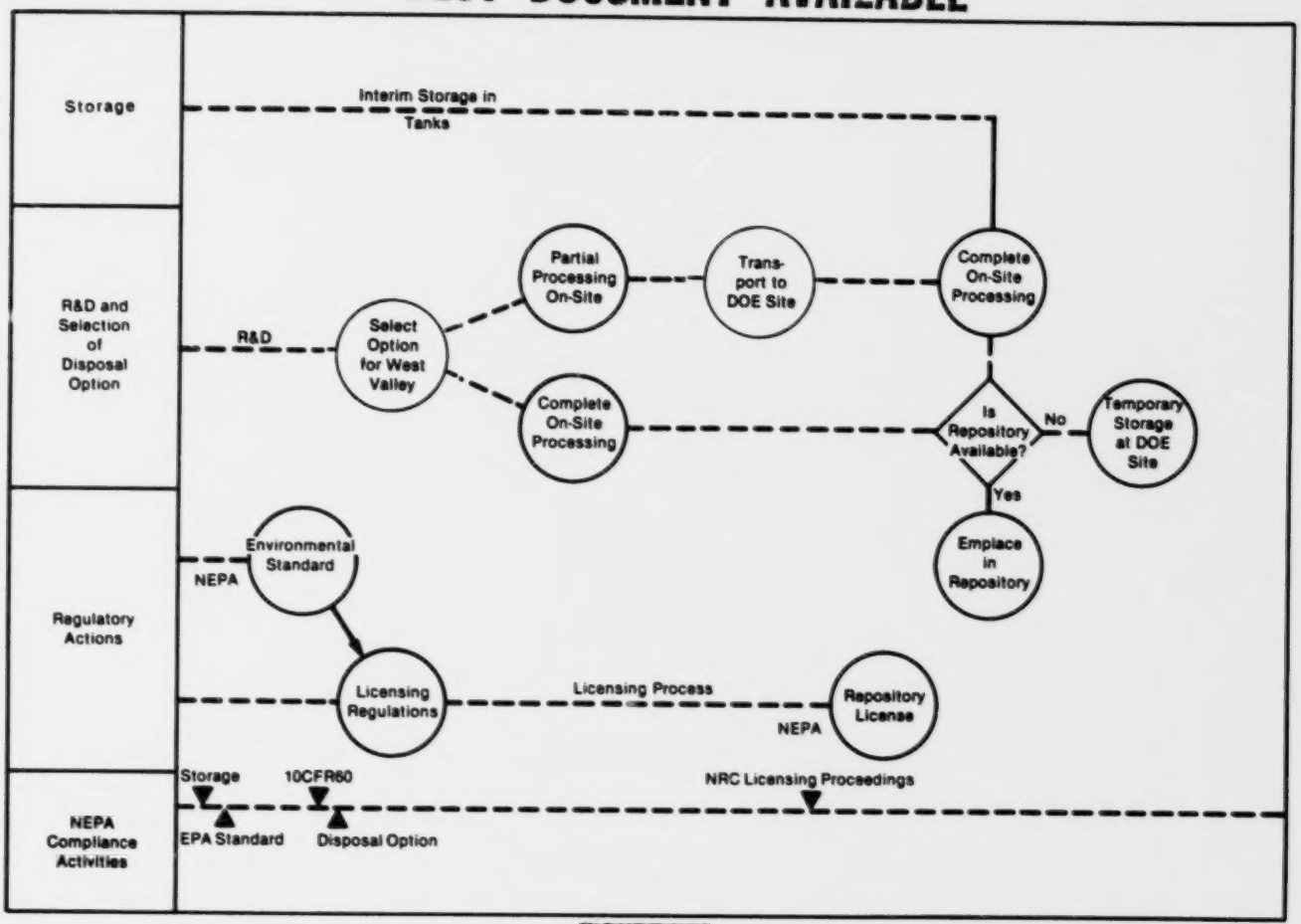
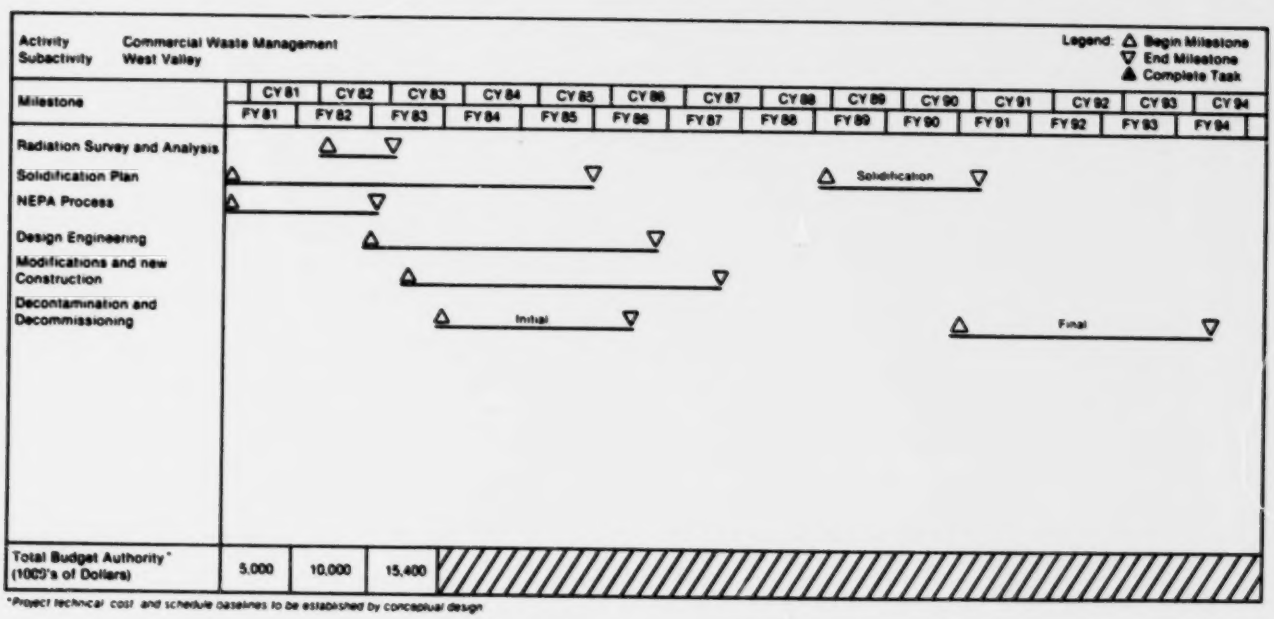


FIGURE 3-12
GENERIC STRATEGY FOR LONG-TERM MANAGEMENT OF HIGH-LEVEL WASTE


Activity Commercial Waste Management
Subactivity West Valley
Legend: Begin Milestone
End Milestone
Complete Task
Milestone
CY 81 CY 82 CY 83 CY 84 CY 85 CY 86 CY 87 CY 88 CY 89 CY 90 CY 91 CY 92 CY 93 CY 94
FY 81 FY 82 FY 83 FY 84 FY 85 FY 86 FY 87 FY 88 FY 89 FY 90 FY 91 FY 92 FY 93 FY 94
Radiation Survey and Analysis
Solidification Plan
Solidification
NEPA Process
Design Engineering
Modifications and new Construction
Decontamination and Decommissioning
Initial
Final
Total Budget Authority* (1003's of Dollars)
5,000
10,000
15,400

*Project technical cost and schedule baselines to be established by conceptual design

FIGURE 3-13
WEST VALLEY DEMONSTRATION MILESTONES AND SCHEDULE

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4.0 Nuclear Fuel Cycle

The future of the nuclear power industry is uncertain due in part to failure to close the nuclear fuel cycle. The development of commercial nuclear technology has not been coordinated and, as a result, commercial fuel reprocessing and waste management demonstrations have not advanced at a pace commensurate with reactor deployment. Consequently, an aggressive program is needed by the DOE, the utilities, and industry to foster the availability of these fuel cycle services.

As of April 1, 1982, 76 nuclear power reactors were licensed to operate by NRC, with an additional 98 in various stages of construction or on order. Their locations are shown in Figure 4.1. These commercial Light Water Reactors (LWRs) utilize only a small fraction of the energy available in their fuel. Recycling of plutonium and uranium in LWRs would improve this somewhat (factor of 1.2 to 1.3). A successful breeder reactor system will increase the energy from the nuclear resource by a factor of about 60.

Key
- ● With Operating License
- ○ With Construction Permit
- □ With Limited Work Authorization
- △ On Order

76	Reactors with operating licenses	57,032 MWe
81	Reactors with construction permits	89,228 MWe
2	Reactors with limited work authorizations	2,300 MWe
15	Reactors on order (including 2 units not sited on map)	17,482 MWe
174	Total	166,042 MWe

Source: Atomic Industrial Forum, 1981

FIGURE 4-1
NUCLEAR POWER PLANTS IN THE UNITED STATES

Thus, the spent fuel from an LWR contains significant energy. Spent fuel should be reprocessed for further recycle, preferably in Liquid Metal Fast Breeder Reactors (LMFBRs) where it has far greater value and where existing depleted uranium stockpiles from current uranium enrichment activities can be converted into energy. This depleted uranium, already mined and purified, represents an energy resource that is much greater than known U.S. oil and coal reserves.

This section presents, the DOE integrated strategy and development plan for the nuclear fuel cycle. This plan, which supplements the overall DOE plan to foster enhanced deployment of commercial nuclear power reactors in the U.S., has the following specific objectives:

- Participate in joint demonstration programs with utilities and industry leading to the licensing of alternative LWR spent fuel storage techniques. This will ensure that operation of commercial LWRs will not be impeded by lack of spent fuel storage capability.
- Monitor spent fuel storage capabilities and needs.
- Foster the development of capability in the U.S. to reprocess spent LWR fuel by 1989.
- Foster the establishment, on a consistent schedule, of the necessary supporting capabilities for a commercial LWR fuel reprocessing system, i.e., product conversion, HLW solidification and storage, and TRU waste storage.
- Establish and obtain necessary approvals for waste forms and criteria for acceptance by U.S. Government of high-level, airborne, and transuranic wastes.
- Provide an interim waste storage facility.
- Monitor the needs of nuclear materials transportation and provide support to the industry as needed.
- Demonstrate closing of the LMFBR fuel cycle by 1996.
- Improve the reliability, economics, safety, environmental impact, occupational protection, and safeguardability of nuclear fuel cycles.
- Foster and lead international cooperation in reprocessing and related nuclear fuel cycle activities.

Key assumptions which form the basis of the plan are summarized in Table 4-1.

The DOE Nuclear Fuel Cycle Program is organized into the Spent Fuel Program; Reprocessing Program; and Waste Treatment and Storage Program, each of which is described below.

TABLE 4-1
KEY ASSUMPTIONS OF NUCLEAR FUEL CYCLE PLAN

- Alternative LWR fuel storage technology development and licensing will be completed by 1986.
- Commercial reprocessing begins in 1989.
- The commercial LWR fuel reprocessing plant will have HLW processing, solidified HLW cannister storage, TRU waste storage, and product conversion as needed.
- The decision date on waste form is 1982 for West Valley and/or commercial LWR reprocessing.
- Clinch River Breeder Reactor Plant goes critical on schedule with plutonium fuel in September 1988.
- The Federal Government will acept HLW from industry beginning no later than 1999 and provide an interim storage facility if a repository is not available at that time.
- The decision to deploy LMFBRs, to be made in the 1990s, requires fuel cycle demonstration*.

* As used in this report, demonstration means activities carried out with full levels of radioactivity on a scale and for periods of time that will allow reasonable performance and economic assessments to be made; it also means full compliance with regulatory requirements whether the demonstration facility is licensed or not.

4.1 Spent Fuel

Most of the utilities operating the reactors in Figure 4-1 are presently storing spent fuel discharged from their power reactors in water-filled pools at the reactor sites (Figure 4.2). As a result of recent increases in reactor storage pool capacities, the LWR spent fuel storage capacity in the U.S. is adequate at present. However, by the mid-1980s some reactor pools will need additional capacity to maintain full core reserve, and this situation will rapidly worsen unless additional storage capacities are available on a timely basis. Industry, DOE, and utilities are now developing alternative methods for treating, transporting, and storing spent LWR fuel in order to increase storage capacity.

4.1.1 Spent Fuel Development Plan

The basic strategy is to encourage and jointly participate with industry in license applications for alternative storage technologies. These commercial applications, developed with DOE support, will seek to demonstrate that these technologies are safe and licensable.

In order to continue operating, utilities must be assured of the continued supply of new fuel and provisions for discharging spent fuel from the plant site at an acceptable cost. Since some reactor storage pools will become full in the mid 1980s, several alternatives to "at reactor pool" storage should be licensed and demonstrated. The Federal role in joint technology development should phase out in the mid-to-late 1980s as the private sector assumes full responsibility for demonstrated systems. However, review of utility spent fuel storage requirements and monitoring of the condition of fuel in extended wet and dry storage will be continued.

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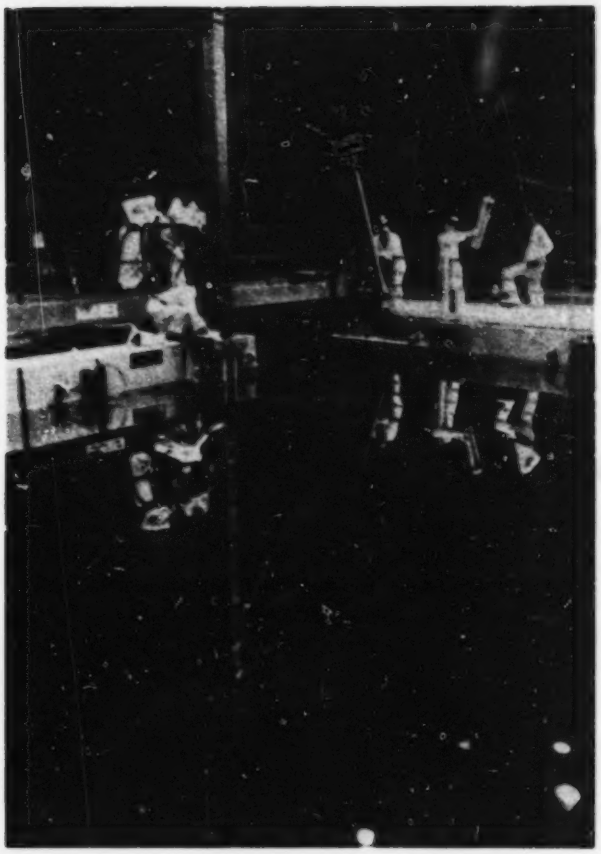

FIGURE 4-2
SPENT FUEL STORAGE POOL AT A REACTOR

DOE has entered into a cooperative program with the Tennessee Valley Authority (TVA) to demonstrate and license boiling water reactor (BWR) rod consolidation operations. This effort is a followup to DOE cold demonstrations[a] of pressurized water reactor (PWR) rod consolidation equipment. Other rod consolitation and dry storage cask cooperation programs are planned. Spent fuel storage program activities concentrate on the support of utility license applications for rod consolidation and dry storage in casks which have the potential to safely and efficiently meet the interim spent fuel storage needs of commercial LWRs. However, assistance and support in the licensing and commercial applications of these storage technologies are needed to demonstrate their validity as optional solutions to the spent fuel storage problems. DOE is working with utilities that have near-term storage problems to explore solutions to their particular needs. Cooperative agreements with utilities and industry need to be completed as soon as possible so that options can be licensed and available by 1986. Activities include monitoring and reporting on spent fuel storage requirements, monitoring spent fuel in wet and dry storage containers, evaluating fuel storage containers, and assuring licensability of the entire system for handling, packaging, and transportation.

[a] Cold demonstrations will be performed under conditions of no radioactivity.

4.1.2 Plan of Action for Spent Fuel

The plan of action for the implementation of the spent fuel program strategy is given below:

- Immediate attention is focused on:
  - (1) Encouraging and participating in utilities' license applications for the alternative storage technologies.
  - (2) Complete fabrication of BWR disassembly equipment for rod consolidation. PWR dissassembly equipment has already been developed.
- Near-term activities will focus on:
  - (1) Demonstration of alternatives to pool storage at reactor sites leading to successful licensing with support from data obtained during unlicensed storage.
- Long-term activities will focus on:
  - (1) Phasing out Federal role in technology development in mid to late 1980s as private sector assumes full responsibility for demonstrated systems.
  - (2) Maintaining surveillance of quantities of spent fuel accumulation and the condition of fuel in extended wet and dry storage.
- Following this approach, the following target dates are anticipated:

1982	Procure and receive cask from Ridihalgh, Eggers and Associates.
1982	establishment of cask storage cooperative development activities with industry and utilities.
1982	Complete agreements for small and large scale tests of consolidated fuel storage, dry storage, shipment of spent fuel in a storage only cask with overpack, etc.
1983	Acceptance of 32 BWR subassemblies for rod consolidation testing.
1984	Completion of cooperative agreements on alternative technologies and support for utilities' licensing applications.
1985	Complete demonstration of alternative storage technologies.
1986	Complete evaluation of failed-fuel storage.

These major spent fuel milestones are shown in Figure 4.3; budget needs are given through FY 1983.

4.2 Reprocessing

Reprocessing of irradiated nuclear fuel has been carried out for decades in the United States and other nations, initially with fuels irradiated for production of materials for

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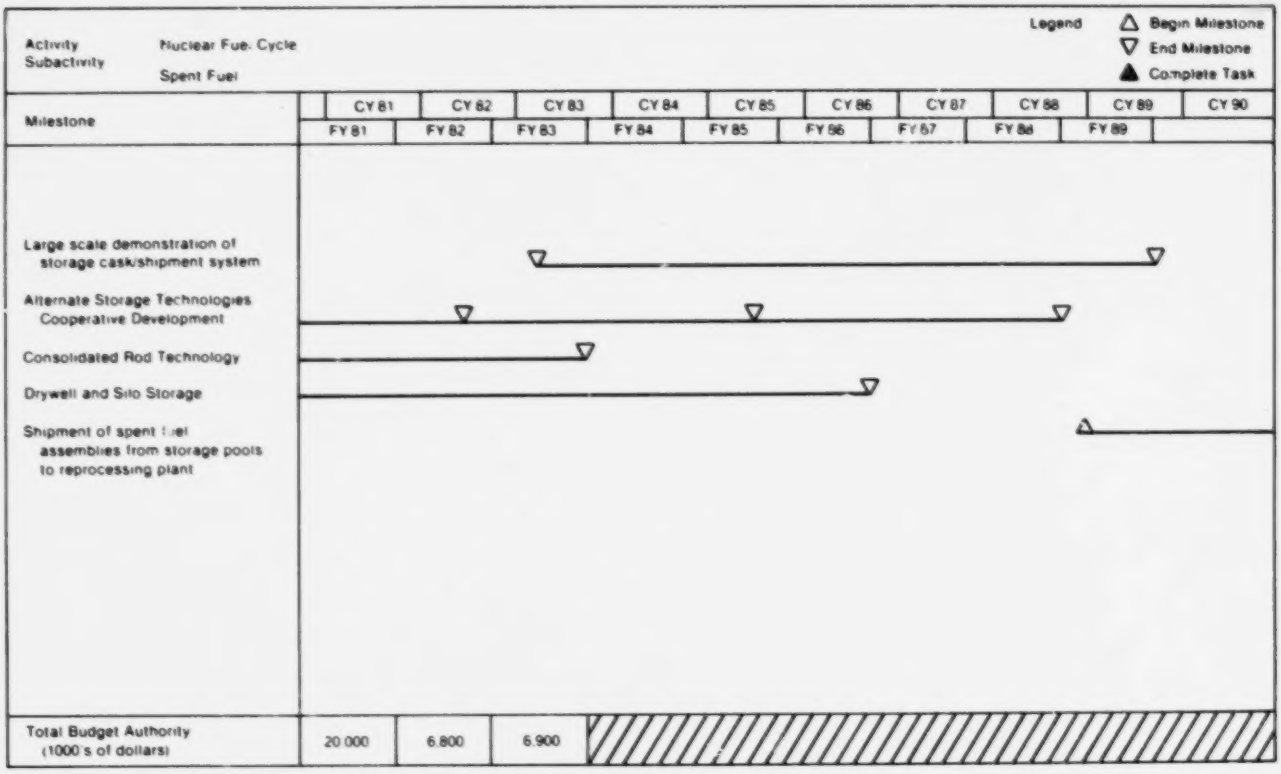

FIGURE 4-3
SPENT FUEL MILESTONES AND BUDGETS

national defense purposes, then later with highly irradiated fuels from light water reactors. Reprocessing of defense program fuels has been successful, and facilities built for these programs have reprocessed irradiated fuels to recover weapons related materials. Commercial LWR fuel reprocessing in the U.S. has been curtailed in the interest of nonproliferation policy over the past several years, but is active in government-supported facilities in the Federal Republic of Germany, France, and Japan, and there are plans for LWR fuel reprocessing in India and the United Kingdom. However, none of the facilities that have operated have demonstrated high on-stream efficiency. In addition to establishing the economics of reprocessing, future plants will provide better radiation protection to the operators, improved safeguards, and generally low releases of radionuclides to the environment. Inherent in this requirement is the need for improvements in treatment, storage, and disposal of radioactive wastes.

Within the United States, there has been a continuing research and development activity and design effort on fuel reprocessing during the past few years by Oak Ridge National Laboratory, Savannah River Laboratory, the Pacific Northwest Laboratory, other DOE contractors, the commercial Barnwell Nuclear Fuel Plant (BNFP), and by private industrial organizations. These efforts have resulted in many technological advances which provide increased assurances that operability, maintainability, safeguards, and environmental and radiation protection of future LWR reprocessing plants will be superior to those of plants built in earlier years. Among the more important achievements are the following:

- Development of centrifugal solvent extraction equipment that minimizes solution residence time, resulting in reduced fissile inventory, reduced solvent degradation and reduced plant start up and shut down times.
- Development of equipment components with features to facilitate remote maintenance and development of remote manipulators to carry out this maintenance.
- Development and cold demonstration of systems for krypton-85 removal from reprocessing plant off-gas.
- Development and partial cold demonstration of a computer controlled process-monitoring/safeguards system for LWR reprocessing plants.
- Demonstration of borosilicate glass waste solidification processes using a small amount of irradiated LWR fuel including prototype off-gas treatment.

The status of technology for reprocessing of LWR fuels, together with success in developments scheduled for completion in the next few years, appears to be adequate to support initial operation of a commercial scale plant in the U.S. by 1989, with reasonable assurance that regulatory requirements for safeguards, environmental protection, and radiation protection will be met, and that a high availability factor will be achieved. It should be noted that BNFP does not now have facilities for HLW solidification and storage, TRU waste management, product conversion, or waste management for krypton-85 or tritium. Although BNFP could initially supply plutonium for the breeder development program, it would not be directly usable for reprocessing LMFBR core fuel without additional modifications.

While some experience has been obtained on the head-end parts of reprocessing breeder fuels, no hot demonstrations of integrated process steps have been done in the U.S. There is extensive experience in the conversion of reprocessing plant products to uranium hexafluoride and plutonium oxide. At present there is limited experience in the U.S. with packaging and transportation of reactor grade plutonium (approximately 20 percent Pu-240).

4.2.1 Reprocessing Development Plan

Technology development and demonstration for the breeder fuel cycle, especially reprocessing, has seriously lagged that of the reactors. It would be highly desirable to demonstrate the breeder fuel cycle concurrent with the operation of the Clinch River Breeder Reactor Plant (CRBRP), recognizing that the first spent fuel will not be available for 2 to 3 years after initial full power operation. The earliest that the LMFBR fuel reprocessing demonstration facilities could be available is the beginning of FY 1996, seven years after the CRBRP is expected to go critical.

4.2.1.1 Breeder Reprocessing Development.

Reprocessing of LMFBR fuel has been under continued development leading toward hot processing demonstrations[9] which are needed because of differences between LWR and LMFBR fuels. The higher fuel burnup and specific power for breeder fuel results in considerably higher radiation levels and heat generation rates than are present with LWR spent fuel. This introduces problems in fuel handling, dissolution, solvent extraction, and the product removal steps. Since LMFBR spent fuel also contains a larger fraction of plutonium than LWR spent fuel, more sophisticated safeguards and criticality control techniques may be required.

A laser fuel disassembly machine and shear device has been designed for the higher heat generation and radioactivity levels. A continuous rotary dissolver has been fabricated and is being tested to assure high dissolution rates. High speed solvent extraction systems have been developed so that modified centrifugal contactors will not only operate at higher radiation levels, but also will reduce the time for startup of the plant. Experimentation with high plutonium concentrations shows that an LMFBR fuel reprocessing plant can be operated with a degree of safety that is comparable to that of other non-reactor nuclear fuel cycle facilities. Work will be required to confirm design of certain components, such as the new dissolver. In addition, advanced concepts of computerized precise process control for handling large quantities of plutonium in an LMFBR reprocessing plant are being developed and limited demonstrations of these advanced systems have been accomplished.

Equipment and systems developed for reprocessing of LMFBR fuels will be cold tested in the Integrated Equipment Test (IET) Facility to provide assurances of long-term operability, ease of maintenance, improved process integration, and good measurement control. Partial integrated process demonstration is expected about September 1982. Specific activities include the following:

- Engineering development of remotely operable and maintainable reprocessing systems, leading to integrated cold operations in FY 1985.
- Development of concept of total remote maintenance (REMOTEX), based on developments in equipment components with modular, remote maintenance features and electromechanical servomanipulators.
- Laboratory and hot cell fuel dissolution, feed clarification, and solvent extraction experimentation to extend data on fissile and fertile recovery and fission product decontamination.
- Design studies of an advanced head-end treatment facility, collocated with an existing LWR reprocessing facility, to provide for demonstration of breeder fuel reprocessing and backup capability for recovery of LWR fuels.

An early demonstration of LMFBR fuel reprocessing is essential to deployment of LMFBRs. Therefore, planning, development, and demonstration of technology and licensing for a LMFBR spent fuel Demonstration Reprocessing Plant (DRP) should be started, to be completed on a time scale consistent with the breeder deployment decision. The DRP and the existing reprocessing plant add-on options will be evaluated for a decision in the latter part of FY 1983, with the focus on completing construction of the LMFBR spent fuel reprocessing plant in 1995 and placing it in operation in 1996, about seven years after CRBRP is planned to go critical.

Preliminary conceptual design for the DRP has been completed, and an environmental analysis has indicated that such a facility can be built and operated within existing and proposed environmental guidelines.

Nominal design capacity for the DRP has been set at 1/2 metric ton of heavy metal per day (MTHM/d), with the provision that it operate effectively down to 0.25 MTHM/d.

[9] Hot demonstrations will be performed with radioactive material.

Preliminary design concepts for the DRP have focused on both a "stand-alone" facility, and the alternative add-on "breeder head-end" to an existing LWR reprocessing plant. Final decision between them will consider cost, environmental impact, licensing implications, and importance of a reliable demonstration. Because the CRBRP discharges only a limited quantity of fuel which is below the capacity of the DRP, it may be necessary to reprocess some LWR fuel if high on-stream time is necessary for successful demonstration.

The management of airborne wastes from reprocessing plants is considered to be part of the plant design and development scope. Regulatory requirements for capture and retention of carbon-14 and tritium are being considered, and requirements for iodine-131 and krypton-85 will be effected shortly. Compliance with these requirements on a commercial scale will require advances in the state-of-the-art technology. Monitoring of evolving regulatory requirements will be continued to provide guidance for the limited technology development now underway. Activities will focus on supporting regulatory requirements for a 1989 startup of the Barnwell Nuclear Fuel Plant and for the DRP in 1995.

The LMFBR development program will help demonstrate an ability to close the back end of the LMFBR fuel cycle through international cooperative arrangements. Means for establishing major international cooperative efforts will be pursued.

4.2.1.2 LWR Reprocessing.

Closing of the LWR fuel cycle is required to make full use of the energy remaining in spent fuel discharged from nuclear fueled central power stations. Reprocessing of LWR fuel, in addition to the recovery of uranium for further use in light water reactors, will provide a supply of plutonium for application in breeder reactors and will ameliorate the long-term waste management problem.

Completion of the BNFP facilities and successful operation of the entire system is needed for a timely U.S. fuel cycle demonstration program. Continuing development activity particularly in the areas of solvent extraction equipment, fuel shear and dissolver system, maintenance systems, safeguards, product conversion, and waste treatment and solidification will permit design, construction, and reliable operation of additional LWR reprocessing plants.

The most timely option to accomplish the successful operation of the entire nuclear fuel cycle is to restart the the Barnwell Nuclear Fuel Plant and complete the associated support facilities in the early 1990's. An appropriate program of development would start construction of required reprocessing plant modifications and the product conversion facility by 1983. The reprocessing plant could be completed by 1988 and the product conversion facility by late 1989, so that limited production of reprocessed fuel could begin. Full operations would begin in 1992. By 1997, the BNFP could have facilities to immobilize all of the radioactive volatile fission products, so that they can be transported to terminal isolation sites.

Research and development work in prior years was planned to advance the state of the art in fuel handling, safeguards, and fuel cycle evaluations. Activities in FY 1983 will in part be directed to investigating those areas that will minimize operational problems and fuel handling, and safeguards systems will be oriented for more direct applications to the operation of the BNFP. Cold operation of BNFP will continue to test key technical concepts and plant operability. The necessary maintenance to keep this option open, prior to a commitment for commercial operation, will be continued.

4.2.2 Plan of Action for Reprocessing

The plan of action is as follows:

- Immediate attention is focused on:
  - (1) Continuation of BNFP testing with emphasis on resolution of potential problems and safeguards development (BNFP licensing is a commercial venture).
  - (2) Continued development of improvements in reprocessing equipment such as laser fuel disassembly and shear, and high speed dissolver and solvent extraction systems.
  - (3) Integrated Equipment and Test (IET) facility completion and operation for LMFBR fuel reprocessing equipment and systems.
- Near-term activities will focus on:
  - (1) Assistance in design requirements of BNFP product conversion facility.
  - (2) Evaluation of facility options for advanced reprocessing for breeder fuels.
  - (3) Design studies for add-on equipment options to allow breeder fuel treatment at LWR reprocessing plants.
- Long-term activities will focus on:
  - (1) Completion of all parts of BNFP for fuel reprocessing and products conversion (a commercial venture).
  - (2) Decision between stand-alone DRP and add-on for LMFBR fuel reprocessing.
  - (3) Completion of the IET project.
- Following this approach the following target dates are anticipated:

1983	Completion of the modular shear, installation, and initiation of testing in the Remote Operations and Maintenance Demonstration.
1983	Complete plans for LWR fuel reprocessing.

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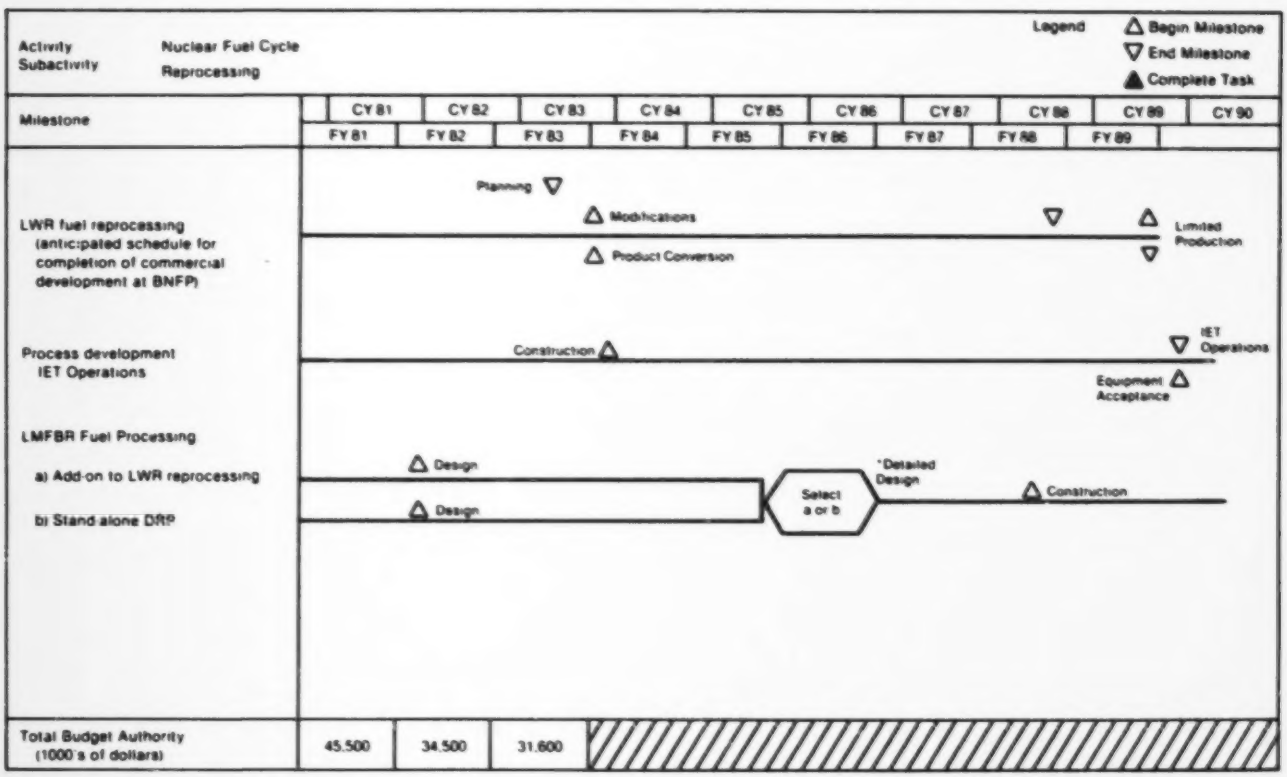
1984	Provide assistance to commercial sector to design and license product conversion equipment.
1984	Full operation of the IET.
1985	Select add-on facility or stand-alone DRP for LMFBR fuel reprocessing.
1985	Begin detailed design of LMFBR fuel reprocessing facility.
1988	Begin construction of LMFBR fuel reprocessing facility.
1989	Begin limited operation of BNFP with LWR fuel.
1991	Complete BNFP product conversion equipment and begin full LWR spent fuel reprocessing.
1992	Complete HLW soldification facility.
1995	Complete construction facilities for breeder fuel reprocessing and cold checkout.
1997	LMFBR reprocessing plant fully operational.

These milestones and budgets up to FY 1983 are shown in Figure 4.4.



*Line item of construction project (architect - engineering only)

FIGURE 4-4
REPROCESSING MILESTONES AND BUDGETS

4.3 Waste Treatment and Interim Storage

Although there exists considerable experience in radioactive waste treatment and storage here and abroad, there has been no commercial-scale plant operated to date to solidify, transport, and store commercial HLW from spent fuel reprocessing.

In the area of transuranic (TRU) waste, the Defense Programs are developing measuring, sorting, concentrating, and isolation methods to augment their already extensive experience. While commercial TRU waste will be different from defense TRU waste (higher radiation levels, etc.), this development plan will build upon the DOE Defense Program technology.

4.3.1 Development Plan for Waste Treatment and Storage

Major HLW treatment development efforts needed are in the areas of waste form selection, and full scale process equipment demonstration for design of a licensable facility. Since typical HLW is not available, testing with radioactive simulated HLW is needed to establish the process flow sheet and equipment performance. Since vitrified borosilicate glass is the current reference waste form, the equipment demonstration receiving the most effort will be the Liquid-Fed Ceramic Melter which will also be used in the Defense Waste Processing Facility and in the West Valley Demonstration Project, both unlicensed. Effects of differences between commercial and defense HLWs (heat loading, chemical composition, etc.) must be assessed to support requirements for the melter demonstration and for eventual plant design. The packaging and transportation system currently used for other radioactive wastes will have to be re-evaluated for this application, and a commercial strategy developed with industry to ensure that the required capability will be available. The reference glass making technology is well in place after many years of domestic and international development. What is needed next is waste form selection, followed by full scale operating reliability, maintenance, testing, and demonstration experience to give reprocessors confidence to proceed. A waste form selection with retention of one back-up waste form will be made in 1982 to be followed by process and equipment specification and demonstration to allow work on the HLW solidification plant to begin.

Development will draw heavily on the Defense Waste Processing Facility technology, early DOE programs at Pacific Northwest Laboratory, and foreign experience. After selection of a waste form, the planning, development, and demonstration will be focused on supporting the start of the HLW solidification plant at West Valley and another at the commercial reprocessing facility. The latter solidification plant could be operable in 1991, two years after the reprocessing plant begins to produce HLW. It must be available within 5 years after the first HLW is produced in order to meet 10 CFR 50 Appendix F regulations. An interim HLW cannister storage facility will be required within 10 years after the first HLW is produced if a repository or other terminal isolation capacity is not available.

The vital operability, reliability, and maintenance demonstrations will be performed on an expedited basis as waste material becomes available. Extended cold demonstrations with existing liquid-fed melter equipment can begin soon. The design and modifications for radioactive demonstrations will take place by 1983. An early demonstration of prototype equipment will be performed on Three Mile Island (TMI) reactor epicor liners and SDS filters with equipment designs and specifications developed in the HLW program. The same equipment will be installed in the West Valley plant for further demonstration through the completion of that project. Finally, the information gained from these demonstrations will be used to modify equipment being installed in the reprocessing plant and to define operating and maintenance procedures. Development of the packaging and transportation systems will be done in parallel to the HLW treatment and storage program and will utilize the spent fuel transportation technology. All activities will be closely coordinated with developments in the geologic Waste Isolation Program.

Conceptual design of the reference facility concept for providing an interim storage capability for radioactive wastes generated from reprocessing spent fuel will be initiated. This facility will enable the government to contractually commit to accept solidified waste from a commercial reprocessor and provide necessary interim storage until a repository is available. Studies will be performed to establish the preferred storage option for the facility and to define facility-site interfaces. Engineering development and additional studies that might be needed to support the facility design, construction, and operation will be defined and initiated. In parallel with technical activities, efforts will be initiated to investigate facility licensing, financial support from the utilities, fees for storage, and other institutional matters.

The TRU waste program development needs include early identification of the projected amounts and types of wastes. In addition, differences in requirements for handling, packaging, transportation, interim storage, and final isolation of commercial TRU waste compared to defense TRU waste must be identified in order to plan a meaningful development program. TRU wastes may be emplaced in a waste isolation repository requiring close coordination with the Waste Isolation Program. The major facility/equipment items needed for TRU waste management are for improved analysis and sorting, proven volume reduction systems, and a licensable interim storage facility design.

4.3.2 Plan of Action for Waste Treatment and Storage

The following elements comprise the specific plan of action for treatment of HLW and TRU waste from commercial spent fuel reprocessing plants:

- Immediate attention is focused on:

  (1) Critical review and monitoring of present requirements on gaseous radioactive fission products Kr-85, I-129, C-14 and H-3.

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(2) Demonstration of process and equipment for HLW solidification.

(3) Clear definition of TRU waste management requirements.

(4) Interim Storage facility conceptual design.

- Near-term activities will focus on:

(1) Development and selection of HLW waste form.

(2) Waste management facility design support for BNFP.

(3) For TRU waste, volume reduction methods, sorting, handling, and packaging for interim storage facility design.

(4) Technology for immobilizing gaseous radioactive fission products.

- Long-term activities will focus on:

(1) Demonstration of HLW treatment on wastes from TMI and West Valley.

(2) Support completion of construction of BNFP.

(3) Breeder HLW solidification process.

- Following this approach, the following target dates are anticipated:

1982	Waste form selection for LWR HLW.
1982	Begin interim storage facility conceptual design.
1983	Begin HLW solidification equipment conceptual design.
1985	Begin breeder HLW waste form development.
1988	Complete selection of breeder HLW waste form.
1988	Submit license application for interim storage facility.
1990	Complete breeder HLW waste form process development.

Milestones and budgets up to FY 1983 are shown in Figure 4.-5.

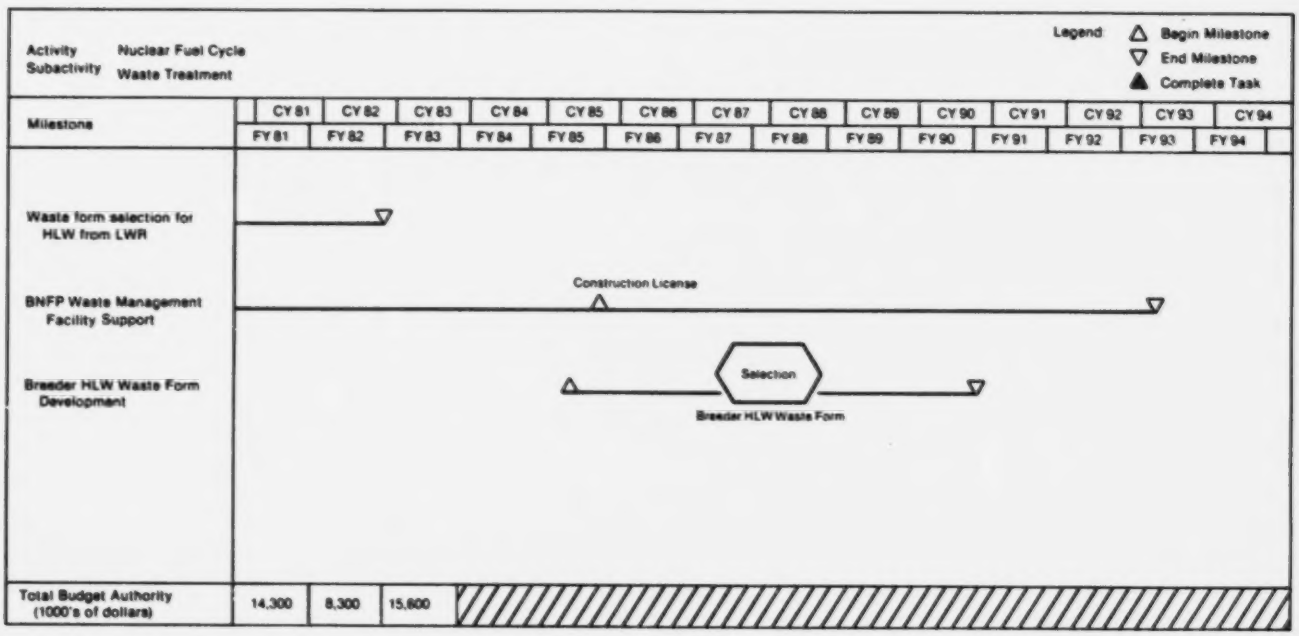
Activity Nuclear Fuel Cycle
Subactivity Waste Treatment
Legend: Begin Milestone
End Milestone
Complete Task
Milestone
CY 81 CY 82 CY 83 CY 84 CY 85 CY 86 CY 87 CY 88 CY 89 CY 90 CY 91 CY 92 CY 93 CY 94
FY 81 FY 82 FY 83 FY 84 FY 85 FY 86 FY 87 FY 88 FY 89 FY 90 FY 91 FY 92 FY 93 FY 94
Waste form selection for HLW from LWR
BNFP Waste Management Facility Support
Construction License
Breeder HLW Waste Form Development
Selection
Breeder HLW Waste Form
Total Budget Authority (1000's of dollars)
14,300
8,300
15,600

FIGURE 4-5
WASTE TREATMENT MILESTONES AND BUDGETS

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5.0 Remedial Action Program

DOE maintains a program for managing the decontamination and decommissioning (D&D) of all surplus nuclear facilities it owns. In addition, DOE is managing a program to conduct remedial actions to eliminate potential radiological exposure to people and potential harm to the environment due to residual contamination at formerly utilized laboratories, manufacturing or processing sites, and at certain inactive uranium mill tailing storage sites.

The DOE commercial Remedial Action Program is divided into the following subactivities:

- Formerly Utilized Manhattan Engineer District/Atomic Energy Commission (MED/AEC) Sites - Conduct remedial action at sites having radiological contamination above current unrestricted guidelines. This potentially includes about 35 locations, although current DOE authority is limited to 14 locations.
- Uranium Mill Tailings Remedial Action Program - Implement remedial actions at inactive uranium mill tailings sites as required by public law. This includes 24 designated sites and about 5000 vicinity properties.
- Grand Junction Remedial Action Program - Remove tailings from Grand Junction structures as required by public law. It is estimated that 740 structures qualify for remedial action.
- Surplus DOE Facilities - Conduct decontamination and decommissioning (D&D) of some 100 surplus radioactively-contaminated DOE facilities. This program includes decommissioning the Shippingport Atomic Power Station.

The goal is to perform the remedial actions in a cooperative program with the States, to meet EPA environmental standards, and to eventually dispose of the wastes from these programs in either NRC-licensed facilities for mill tailings wastes, or, in the case of surplus facilities and the formerly utilized MED/AEC sites, on DOE-owned sites.

The Assistant Secretary for Nuclear Energy (ASNE) has the primary responsibility for Remedial Action Program. The Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness also has specific assignments within the program; these responsibilities are the conducting of radiological surveys, determination of need for cleanup operational safety and environmental audits, participation in determination of priorities in remedial action projects, review of documents required by the National Environmental Policy Act (NEPA) prepared by the Office of Nuclear Energy, and certification of compliance with criteria after completion of projects.

The ASNE has the responsibility for technology development and testing, operations projects, preparation of NEPA documents, participation in determination of priorities, implementation of remedial actions, and other activities necessary to carry out the Department's programs.

The Assistant Secretary for Defense Programs has the responsibility to conduct a program of D&D for those DOE surplus facilities which are related to defense activities.

The following subsections briefly describe the activities underway or planned by DOE to complete the remedial actions on the sites for which DOE has the legal authority and responsibility. The time and resources needed to complete the programs are shown.

5.1 Formerly Utilized MED/AEC Sites Remedial Action Program

In the 1940's and 1950's, the Federal government contracted with private firms to develop processes and perform research projects on radioactive materials; many of these programs included storage and processing of uranium and thorium. While the sites where this work was done were decontaminated to the requirements of that time, these cleanup efforts were not sufficient to meet today's standards for unrestricted use.

Beginning in 1974, the Federal government resurveyed these formerly utilized sites, now on private lands. A need for potential remedial action has been identified at 35 sites (Figure 5.1). In 1978, DOE established a Formerly Utilized Sites Remedial Action Program (FUSRAP) and began planning for decontamination of these sites.

While DOE has clear legal authority to clean up 14 of these sites, 21 other sites need further Congressional authorization. Consequently, in 1980, the Residual Radioactive Material Control Act was drafted and submitted to the Office of Management and Budget for review prior to Congressional introduction in 1982 or 1983.

The DOE strategy to complete this program consists of the following elements:

- Radiological surveys, characterization, environmental review, and monitoring will be an ongoing program of DOE's Assistant Secretary for Environmental Protection. Final certification that EPA standards have been met, and NRC licensing of disposal sites, will occur as each site is decontaminated or decommissioned.
- Engineering planning for alternative remedial actions will include environmental analyses and either Environmental Impact Statements or Environmental Assessments to comply with NEPA, prior to selection of a remedial action.

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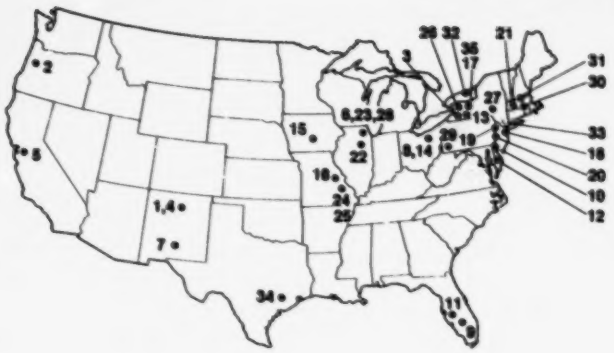

1. Acid/Pueblo Canyon
2. Albany Metallurgical Research Center
3. Ashland Oil Company
4. Bayo Canyon
5. University of California
6. University of Chicago
7. Chupadera Mesa
8. Cleveland Metals, Inc.
9. Conservy Inc.
10. E.I. DuPont & Company
11. Gardinier, Inc.
12. W.R. Grace & Company
13. Guterl Steel Corp.
14. Harshaw Chemical Company
15. Iowa State University
16. Kellex
17. Linde Air Products
18. Mallinckrodt, Inc.
19. Middlesex Landfill
20. Middlesex Sampling Plant
21. National Guard Armory
22. Olin Chemical Company
23. Palos Park
24. St. Louis Airport
25. St. Louis Airport Vicinity Properties
26. Seaway Industrial Park
27. Seneca Army Depot
28. Shpack Landfill
29. Universal Cyclops, Inc.
30. Ventron Corporation
31. Watertown Arsenal
32. Ashland #2
33. Staten Island
34. Pasadena Chemical
35. Niagara Falls Storage Site Vicinity Properties

FIGURE 5-1
LOCATION OF SITES THAT REQUIRE OR MAY REQUIRE REMEDIAL ACTION

- Any buildings on the site will be decontaminated and decommissioned, and all contaminated land and residues will be cleaned up and removed; or the waste may be stabilized in place if this can be accomplished in an environmenally-sound manner.
- The States will recommend new offsite disposal areas for DOE to acquire; in some cases, existing DOE disposal sites will be used. In other cases, ocean disposal is being considered, and an application to EPA for a permit will be required.

If the Residual Radioactivity Material Control Act is passed by Congress as proposed by DOE, both EPA and NRC will have overview roles. EPA will set cleanup standards, and NRC is responsible for regulation and licensing of the final disposal site(s). Pending passage of this legislation, DOE will establish cleanup standards in consultation with EPA, but NRC will not be responsible for licensing of the final disposal sites. These interagency relationships are shown with the overall strategy in Figure 5.2.

The estimated timeframe to complete the Formerly Utilized Sites Remedial Action Program is ten years from the authorizing legislation for the 21 sites for which DOE needs further authority. Figure 5.3 shows the major milestones of the program, assuming the passage of the authorizing legislation in 1982 and adequate funding. Budget appropriations in FY 1981 and FY 1982 and the budget required for FY 1983 are shown. A baseline cost estimate is being prepared. The plan of action for FUSRAP is given below:

- Immediate attention is focused on:
  - (1) Review and introduction of authorizing legislation.
  - (2) Continuation of ongoing surveys and engineering studies of 13 sites (remedial action has been completed on one site).
  - (3) Compliance with NEPA.
  - (4) Completion of the program implementation plan.
  - (5) Identification of disposal options.
  - (6) Completion of remedial actions at two sites.
- Near-term activities will focus on:
  - (1) Completion of engineering and design studies.
  - (2) Completion of all necessary EIS's and EA's.
  - (3) Completion of remedial actions on 5 sites by 1984.
  - (4) Begin remedial action on the remaining sites.
- Long-term activities will focus on:
  - (1) Completion of remedial action on all 35 sites.
  - (2) Certification of sites to assure EPA standards have been met.
  - (3) Licensing of disposal sites by NRC.
  - (4) Maintenance and monitoring of all disposal sites.
- Following this approach, the following target dates are anticipated:

1982	Complete preliminary engineering reports, program implementation plan, and identify disposal options.
1982-1983	Introduction and passage of authorizing legislation.
1983	Complete remedial actions on Bayo Canyon, Acid/Pueblo Canyon, and Shpack projects; continue engineering design studies; identify disposal sites in New York and New Jersey or continue on permit application for LLW disposal in the ocean.
1984	Complete remedial action on 5 high-priority sites.
1987	Complete remedial action on 9 high-priority sites.
1992	Complete FUSRAP program on all 35 sites.

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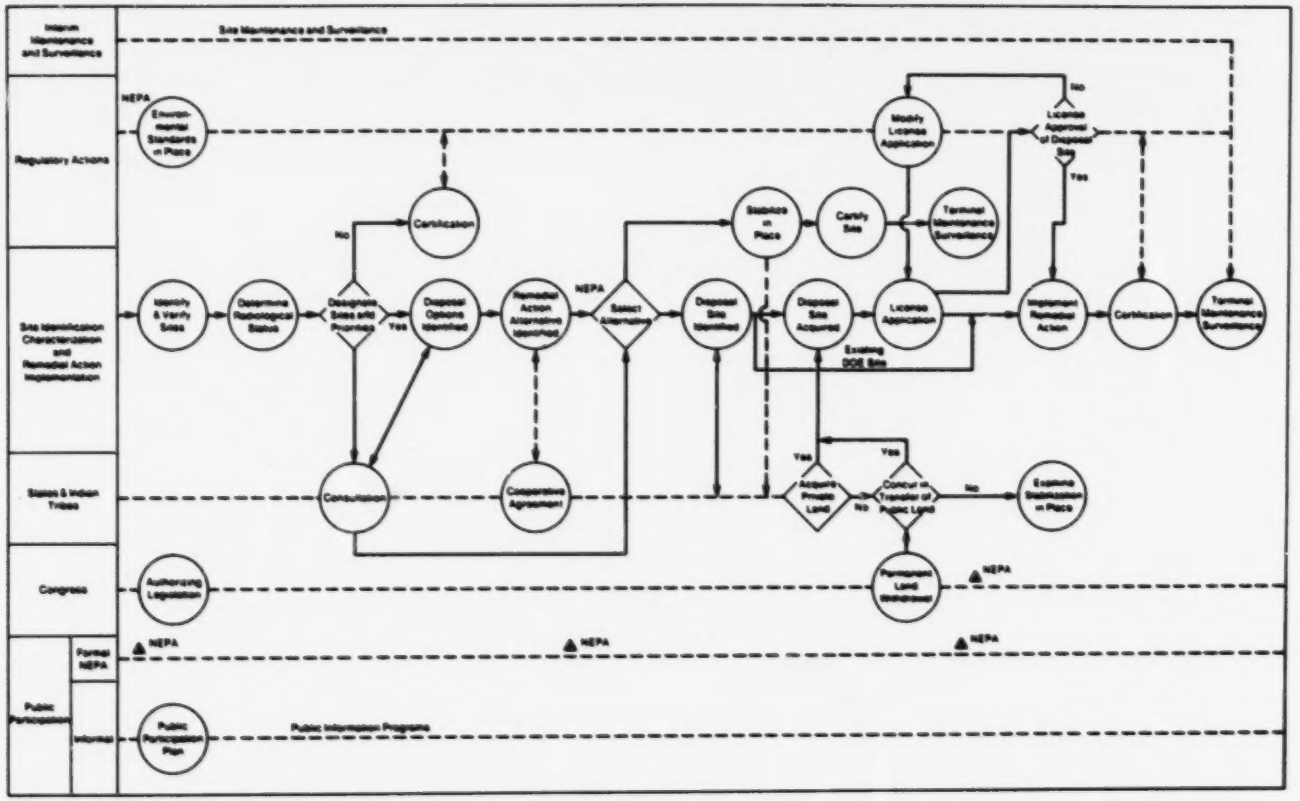

FIGURE 5-2
REMEDIAL ACTION STRATEGY FOR FORMERLY UTILIZED MED/AEC SITES

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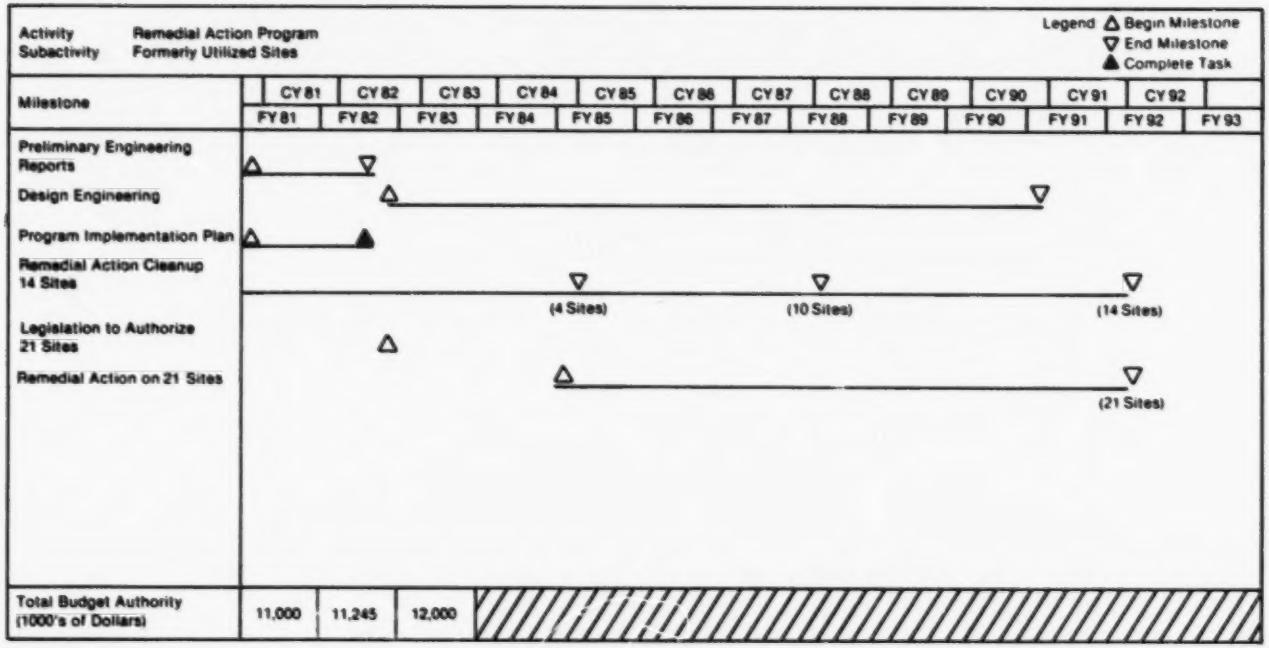
Activity Remedial Action Program
Subactivity Formerly Utilized Sites
Legend △ Begin Milestone
▽ End Milestone
▲ Complete Task
Milestone
CY 81 CY 82 CY 83 CY 84 CY 85 CY 86 CY 87 CY 88 CY 89 CY 90 CY 91 CY 92
FY 81 FY 82 FY 83 FY 84 FY 85 FY 86 FY 87 FY 88 FY 89 FY 90 FY 91 FY 92 FY 93
Preliminary Engineering Reports
Design Engineering
Program Implementation Plan
Remedial Action Cleanup 14 Sites
(4 Sites)
(10 Sites)
(14 Sites)
Legislation to Authorize 21 Sites
Remedial Action on 21 Sites
(21 Sites)
Total Budget Authority (1000's of Dollars)
11,000
11,245
12,000

FIGURE 5-3
FUSRAP MILESTONE SCHEDULE

5.2 Uranium Mill Tailings Remedial Action Program

When taken from the mine, uranium ore consists of rock containing small amounts of uranium and other minerals. At the uranium mill, the ore is crushed and processed to extract most of the uranium in the form of uranium oxide, or "yellowcake." Over 99 percent of the original processed ore becomes mill tailings, which consist of sand and slimes which contain the remaining uranium and most of the radioactive daughter products resulting from the radioactive decay of uranium. The daughter products of principal concern are radium-226 and its daughters, including radon-222. There are currently some 25 million tons (19 million cubic meters) located at inactive processing sites in 10 States (Figure 5.4).

Three major Federal agencies are involved in uranium mill tailings control. DOE is the lead agency for the Grand Junction and Uranium Mill Tailings Remedial Action Programs, two programs authorized by Congress in 1972 and 1978. The States, local governments, Indian Tribes and the public are all actively involved in these programs. The EPA sets standards for radiological conditions used in the designation and certification of sites and after tailings cleanup. NRC develops regulations and guidelines based upon EPA standards and has the lead role in regulating active mills in non-Agreement States.

In 1978, the Congress, under the Uranium Mill Tailings Radiation Control Act (UMTRCA), authorized DOE to enter into State and Indian Tribe Cooperative Agreements to clean up uranium mill tailings at certain inactive processing sites. UMTRCA (PL 95-604) requires concurrence by NRC in the DOE's remedial action plans for executing this program, and NRC licensing of all final tailings disposal sites following completion of remedial actions.

In 1979, DOE designated 24 inactive uranium mill tailings sites which qualify for remedial action. These sites resulted from the production of uranium in earlier years for the U.S. Atomic Energy Commission (AEC). Figure 5.5 shows one of these high-priority sites at Canonsburg, Pennsylvania. Where these sites do not meet the EPA radioactivity standards, DOE is developing programs to clean up abandoned, inactive sites, to stabilize tailings in place, or to remove them to other locations for stabilization. The UMTRCA also authorizes remedial action on vicinity properties; these are approximately 6000 sites which were contaminated with tailings from the original 24 sites. DOE is authorized to pay 90 percent of the costs of the remedial actions, and States will pay the remaining 10 percent, except in the case of Indian lands, where DOE is authorized to pay the entire cost. The Federal government will ultimately own and manage, under NRC license, all final disposal sites. The NRC has issued regulations and technical criteria for the licensing of inactive tailings sites. EPA standards are expected in 1982. Interagency relationships are shown in the overall strategy depicted in Figure 5.6.

Figure 5.7 shows the DOE plan to meet the requirements of UMTRCA, within 7 years of the promulgation of EPA final standards. Certification activities may take place through 1990. The resources needed through FY 1983 are also shown.

The plan of action for the uranium mill tailings programs is given below:

- Immediate attention is focused on:
  - (1) Promulgating final EPA cleanup and disposal standards.
  - (2) Identifying and designating all vicinity properties.
  - (3) Initiating cleanup of high-priority vicinity properties (e.g., Canonsburg and Salt Lake City).
  - (4) Preparation of Remedial Action Concepts and Plans.
  - (5) Beginning NEPA process and completing all Cooperative Agreements.
  - (6) Identifying disposal sites for wastes.
  - (7) Research and development to improve radiological control methods.
- Near-term activities will focus on:
  - (1) Acquisition of tailings or disposal sites as required.
  - (2) Beginning remedial actions on high-priority tailings sites.
  - (3) Completing all NEPA activities (Figure 5.8).
- Long-term activities will focus on:
  - (1) Completing all remedial actions on inactive mill tailings.
  - (2) Certifying cleanup to meet EPA standards.
  - (3) Licensing of disposal sites by NRC.
  - (4) Maintaining and monitoring disposal sites.
- Following this approach, the following target dates are anticipated:

1982	Continue remedial actions on high-priority vicinity properties (Canonsburg and Salt Lake City); complete remedial action concept plans for high-priority UMTRAP sites.
1983	Continue remedial action on Canonsburg and Salt Lake City vicinity properties; begin vicinity property work at Grand Junction, Durango, and Rifle; complete concept plans for all 24 sites; complete detailed engineering plans for high-priority sites; complete NEPA process for high-priority sites; acquire high-priority processing and disposal sites.

1984	Complete the NEPA process, and begin remedial actions on high-priority sites.	1989	Complete all remedial actions on 24 sites.
1987	Complete all concept planning, and complete remedial actions on high-priority sites.	1990	Complete certification of cleanup and licensing of disposal sites.

FIGURE 5-4
INACTIVE URANIUM MILL TAILINGS SITES

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FIGURE 5-5
UMTRAP SITE IN CANONSBURG, PENNSYLVANIA

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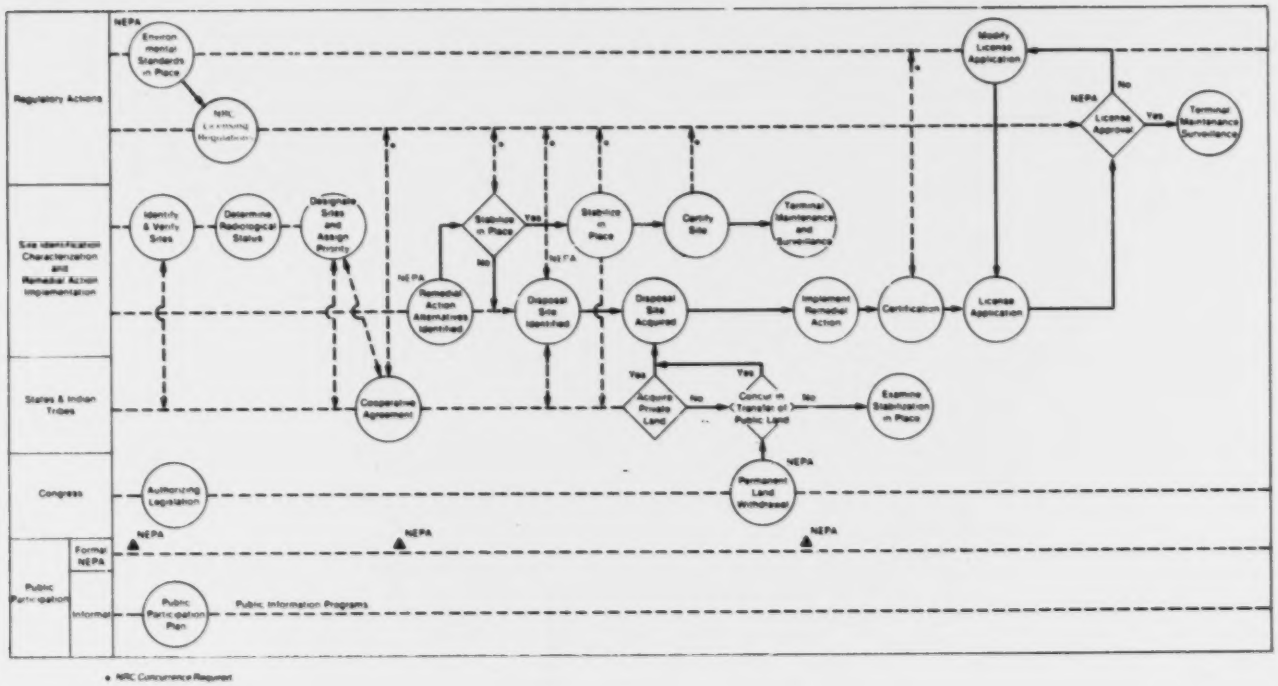

FIGURE 5-6
URANIUM MILL TAILINGS STRATEGY

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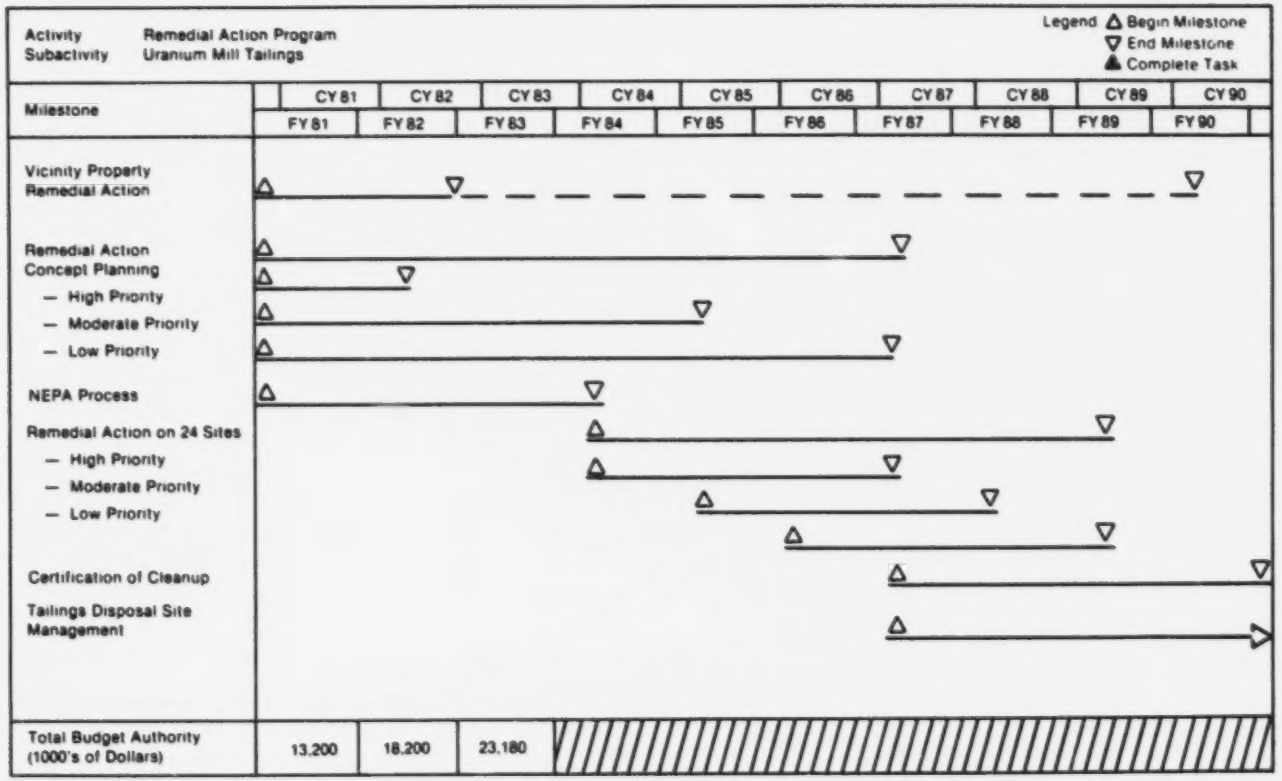

FIGURE 5-7
UMTRA PROGRAM MILESTONES AND SCHEDULE

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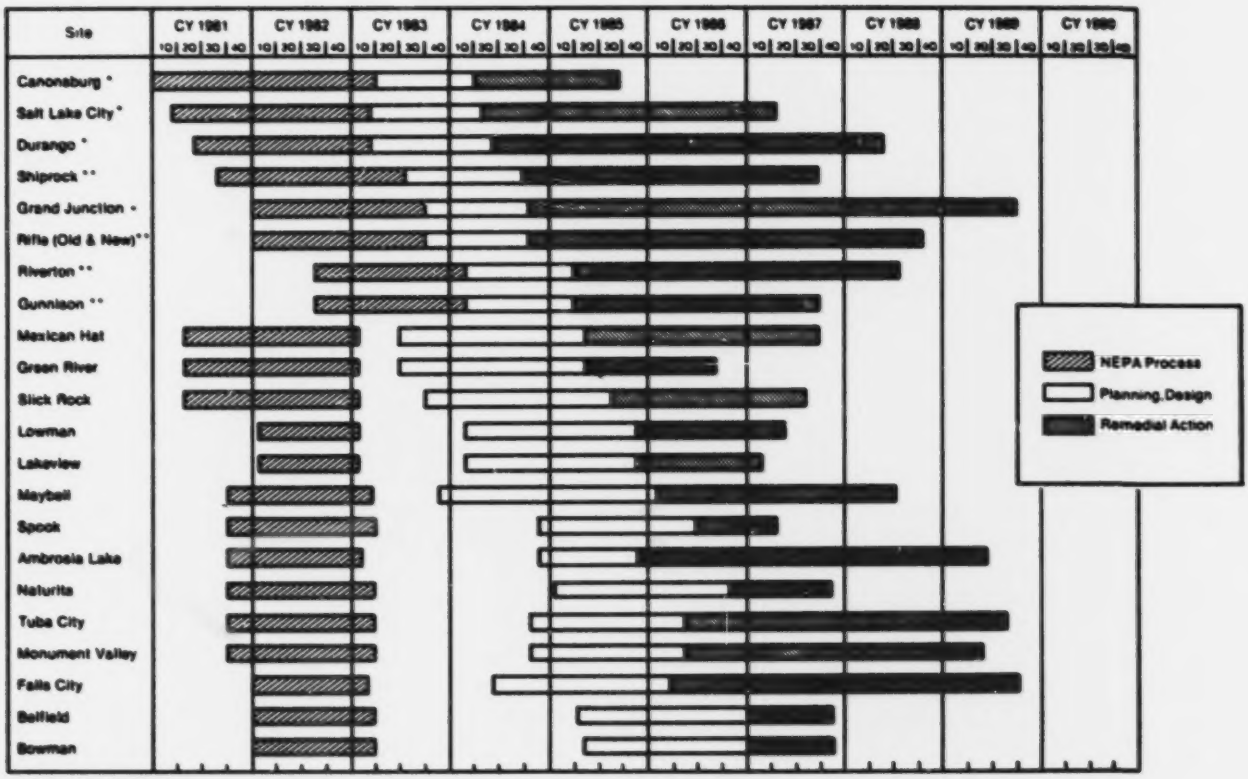

*EISs to be Prepared
**EISs or EAs, as Appropriate

FIGURE 5-8
PRELIMINARY URANIUM MILL TAILINGS PROGRAM SCHEDULE

5.3 Grand Junction Remedial Action Program

Between the years 1952 and 1966, several hundred thousand tons of tailings were removed from the Climax Uranium Company's mill tailings pile in Grand Junction, Colorado (Figure 5.9), and used locally as landfill and construction material. In 1966, when the Colorado Department of Health and the U.S. Public Health Service discovered this fact, release of tailings was stopped, and investigations were begun into the potential radiological health effects of their use in residential and commercial or civic construction. In 1972, the U.S. Surgeon General issued guidelines for determining the need for corrective action at those locations where increased levels of radiation were measured as a result of the presence of construction-related tailings. As a matter of "compassionate responsibility," the Congress passed PL 92-314 in 1972 (amended in 1978 by PL 95-236), authorizing Federal appropriations to assist the State of Colorado in conducting a remedial action program at Grand Junction. The objective of the Grand Junction program is to perform corrective action at occupied sites where radiation exposures exceed the Surgeon General's guidelines. The Grand Junction program is a State-operated activity, with DOE providing 75 percent of the funding and the State 25 percent.

The program to clean up the contaminated structures in Grand Junction began in 1973. Through FY 1981, remedial action has been undertaken on 433 structures. The radiological assessment program has identified approximately 740 structures that will require some form of remedial action to comply with the Surgeon General's Guidelines. The main source of tailings, the inactive site shown in Figure 5-9, receives the tailings from the cleanups of structures and is to be cleaned up under the UMTRAP plan of remedial action.

Based on the potential hazard, the State and DOE establish priorities for cleanup. Schools and the more highly contaminated dwellings are given first priority. The number of structures which can be cleaned up each year has been determined by available State and Federal funding.

Whenever possible, the contaminated sites are cleaned up by excavation and removal of tailings. Where complete removal is not possible, epoxy sealant or increased ventilation and filtration, or a combination of these, are employed to reduce radon gas in the structures to satisfactory levels. Planned remedial actions in Grand Junction will continue through FY 86, and effectiveness checking through FY 88. This strategy to complete the Grand Junction program is shown on Figure 5.10.

Public participation in the Grand Junction Program is obtained through a local Advisory Committee which operates as a government/citizen coordination group to help maintain the flow of information between program officials and the general public.

Figure 5.11 shows the major milestones of the Grand Junction program, with the budget needs given through FY 1983. The plan of action for the Grand Junction program is given below:

- Immediate attention is focused on:
  (1) Cleanup of sites at a rate of about 50 per year.
- Near-term activities will focus on:
  (1) Completion of the remedial action program.
- Long-term activities will focus on:
  (1) Certification and effectiveness checking completed.
  (2) Disposition of Grand Junction tailings under the UMTRAP.
- Following this approach, the following target dates are anticipated:

1982	Completion of the cleanup of 40 additional sites.
1983	Completion of 550 sites; continue radiological assessments; initiate remedial actions on 80 additional sites.
1984	Completion of 650 sites.
1986	Completion of the Grand Junction Remedial Action Program (740 sites).
1988	Completion of certification and effectiveness check on all sites.
1989	Disposition of Grand Junction tailings.

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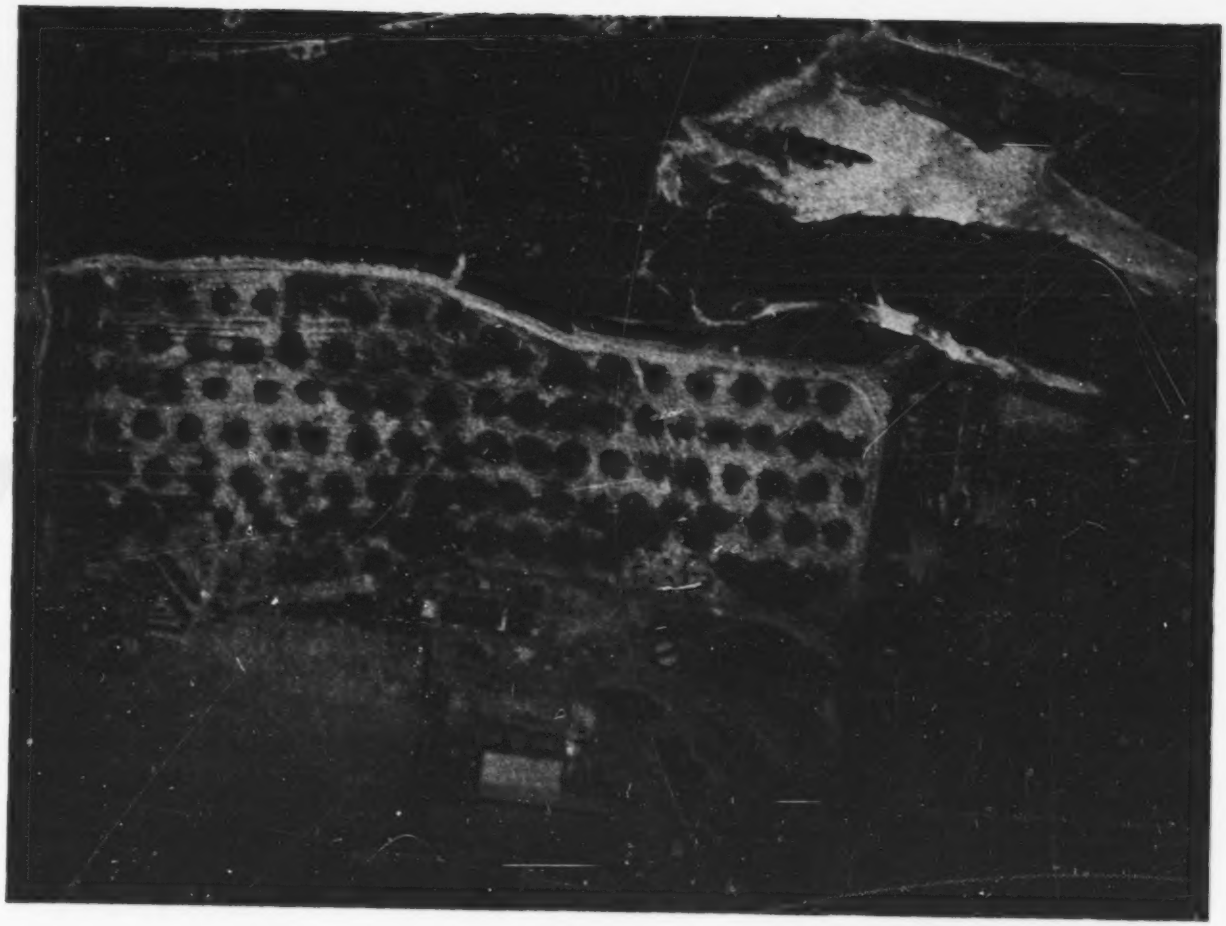

FIGURE 5-9
GRAND JUNCTION URANIUM MILL TAILINGS SITE ALONG THE COLORADO RIVER

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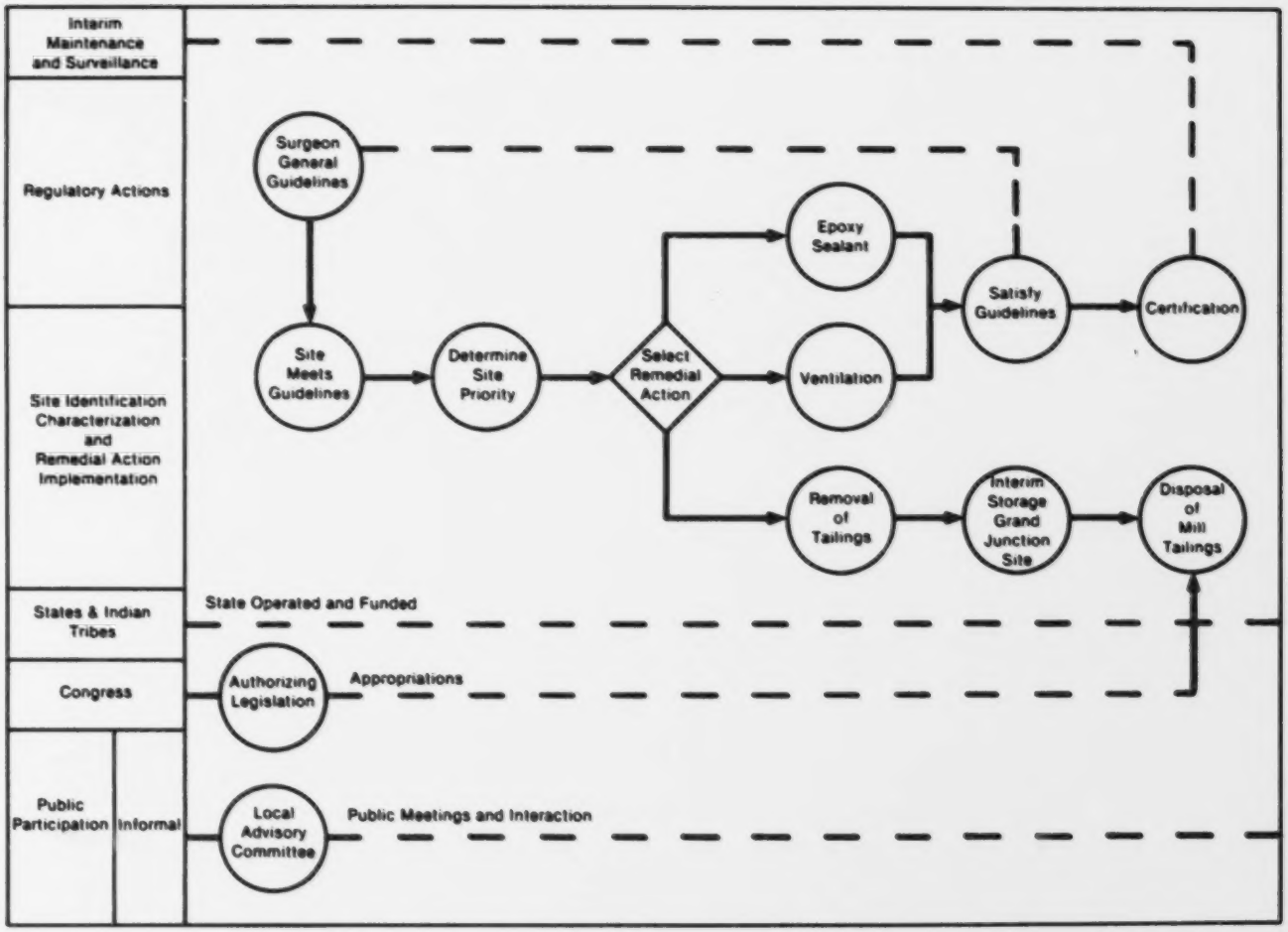

FIGURE 5-10
STRATEGY FOR GRAND JUNCTION REMEDIAL ACTION PROGRAM

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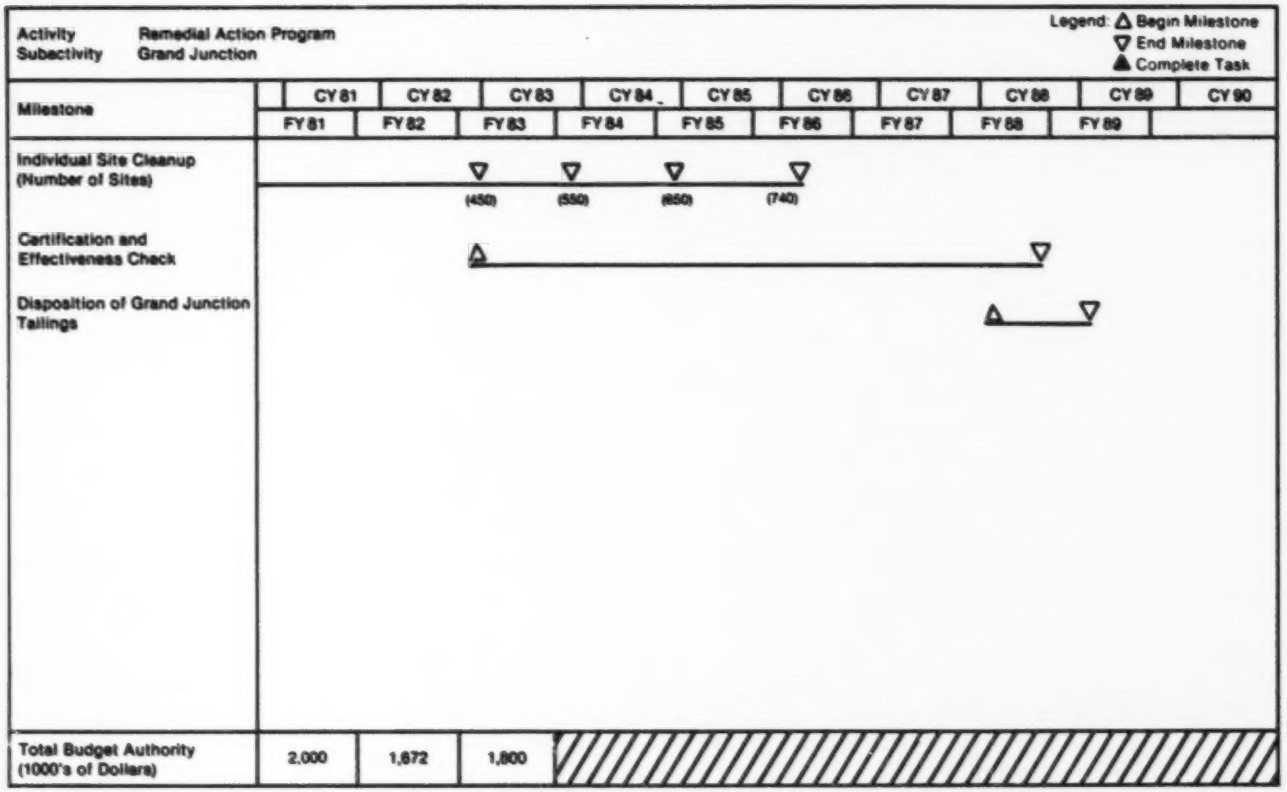

FIGURE 5-11
GRAND JUNCTION MILESTONE SCHEDULE

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5.4 Surplus Facilities Management Program

Since the 1940's, the Federal government has owned property and structures which became radioactively contaminated as part of nuclear experimental programs. In 1976, a survey of surplus facilities was undertaken, and in 1977 a Surplus Facilities Management Program was established within DOE to plan and carry out the disposition of such Federal sites. A 20-year decontamination and decommissioning (D&D) program plan was prepared to clean up DOE-owned surplus facilities. Of the 500 properties, about 100 sites are under the commercial Surplus Facilities Management Program within the Assistant Secretary of Nuclear Energy's jurisdiction. These sites are shown in Figure 5.12.

FIGURE 5-12
LOCATIONS OF DOE RADIOACTIVELY CONTAMINATED SURPLUS FACILITIES (COMMERCIAL PROGRAM)

When nuclear facilities reach the end of their useful life, they will be decontaminated and decommissioned, resulting in low-level wastes, transuranic waste, and occasionally some high-level wastes requiring disposal. The Federal commercial waste plan provides a management scheme for D&D of the sites shown in Table 5.1. The Shippingport Atomic Power Station decommissioning is a high-priority site, and the EIS review is currently underway.

Management of existing surplus contaminated facilities is based on ensuring that no situation of neglect or inadvertent entry will result in exposure to people or degradation to the environment from the release of radioactive material. Priority for D&D actions in surplus facilities is based on an assessment of: (1) potential for exposure to the public or workers involved at the site, (2) reducing the cost of continuing surveillance and maintenance, and (3) making the property available for alternative or unrestricted use. After the priorities are determined, a D&D mode is selected for each site. As shown on Figure 5.13, a decision is made to put the facility in safe storage, or place it in entombment, or to dismantle it completely. Actual decommissioning and decontamination of the site follows, with waste materials buried on Federal lands. Thus, a DOE plan has been prepared which is applicable to the existing inventory of surplus facilities as well as to any future additions. The overall objective of the plan is to eliminate the backlog of commercial surplus facilities by the year 1992. Milestones and budget needs are shown on Figure 5.14.

The plan of action for decommissioning and decontamination for DOE surplus facilities in the commercial program is given below:

- Immediate attention is focused on:
  - (1) Identifying the D&D mode on high-priority DOE surplus facilities (e.g., Shippingport Atomic Power Station).
  - (2) Completing NEPA requirements.
  - (3) Revising the Program Plan for D&D.
  - (4) Assisting in the development of preliminary NRC criteria and regulations.
  - (5) Identifying disposal sites, where DOE-owned lands are not available.
- Near-term activities will focus on:
  - (1) Continuing D&D on mid-priority DOE surplus facilities.
  - (2) Completing high-priority D&D actions.
  - (3) Research and development of D&D methodologies.
- Long-term activities will focus on:
  - (1) Completing D&D on all commercial surplus facilities.
  - (2) Surveillance and maintenance on all disposal sites.
- Following this approach, the following target dates are anticipated:

1982	Completion of a revised D&D Program Plan; completion of Shippingport NEPA process; identification of D&D mode for Shippingport.
1983	Engineering and planning for Monticello project begins; complete D&D on Santa Susana Site and Nuclear Rocket Station on Nevada Test Site; complete Shippingport engineering and design; continue D&D activities on Mound Facility, Richland's project at Cheswick, PA, and Niagara Falls spoils and sealing buildings.
1986	Completion of Monticello project.
1987	Completion of Shippingport project and Santa Susana Site.
1988	Completion of Mound DANSP project.
1991	Completion of Weldon Spring project.
1992	Completion of the current inventory of commercial surplus sites' cleanup.
Post 1992	Maintainance of a program to promptly determine and implement the dispositis associated with each program segment.

Table 5-1
Commercial D&D Projects Under DOE Assistant Secretary for Nuclear Energy

Field Office	*Project*	*Location*
AL	Mound DANSP Areas (PP and R Bldg)	Miamisburgh, OH
	LASL Facilities	Los Alamos, NM
CH	WARD Pu Fuel Fabrication Facility	Cheswick, PA
	BCL Facilities (Research Reactor & Labs)	Columbus, OH
	ANL Facilities	Argonne, IL
GJ	Monticello Mill Tailings Site	Monticello, UT
ID	Boiling Water Reactor Experiment	INEL, ID
	SPERT Test Facilities & Leach Ponds	INEL, ID
NV	Nuclear Rocket Development Station	NTS, NV
OR	CEER	Mayaguez, PR
	Molten Salt Reactor Equipment	Oak Ridge, TN
	Homogeneous Reactor Exp. (HRE-2)	Oak Ridge, TN
	Low Intensity Test Reactor	Oak Ridge, TN
	Niagara Falls Storage Site	Lewiston, NY
	Weldon Spring & Quarry	Weldon Spring, MO
RL	Shippingport Atomic Power Station	Shippingport, PA
SAN	Santa Susana Facilities (SRE & SNAP)	Canoga Park, CA
	Advanced Fuel Lab Equipment (GE)	Vallecitos, CA
	UC-Davis Waste Retention System	Davis, CA
SR	Heavy Water Components Test Reactor	SRL, SC

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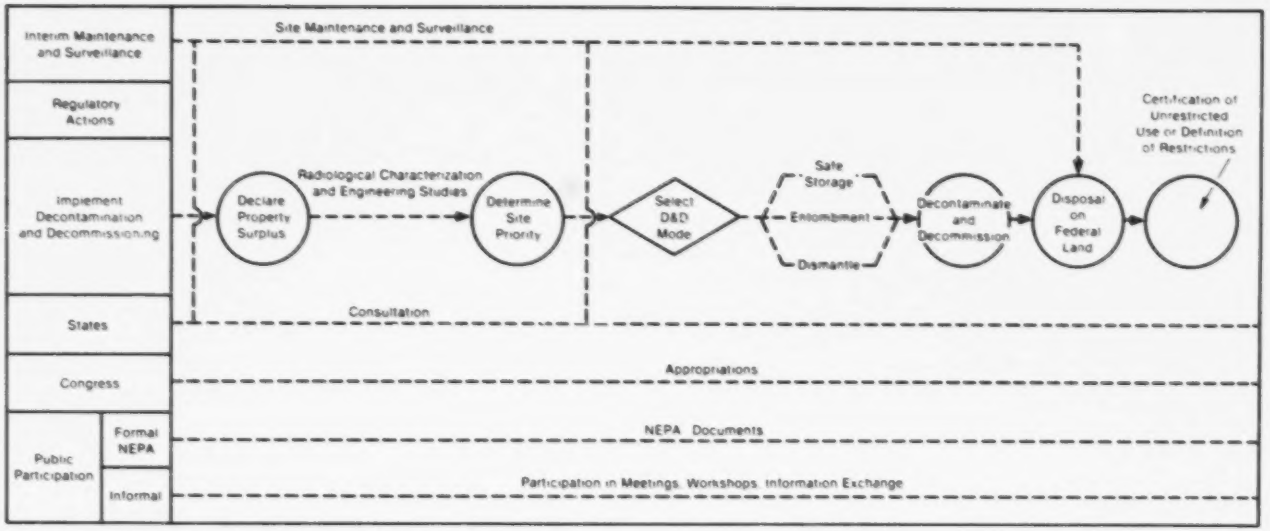

*For certain commercial demonstration sites (e.g., Shippingport) D&D plans will comply with NRC regulations.

FIGURE 5-13
STRATEGY FOR DECONTAMINATION AND DECOMMISSIONING OF DOE SITES

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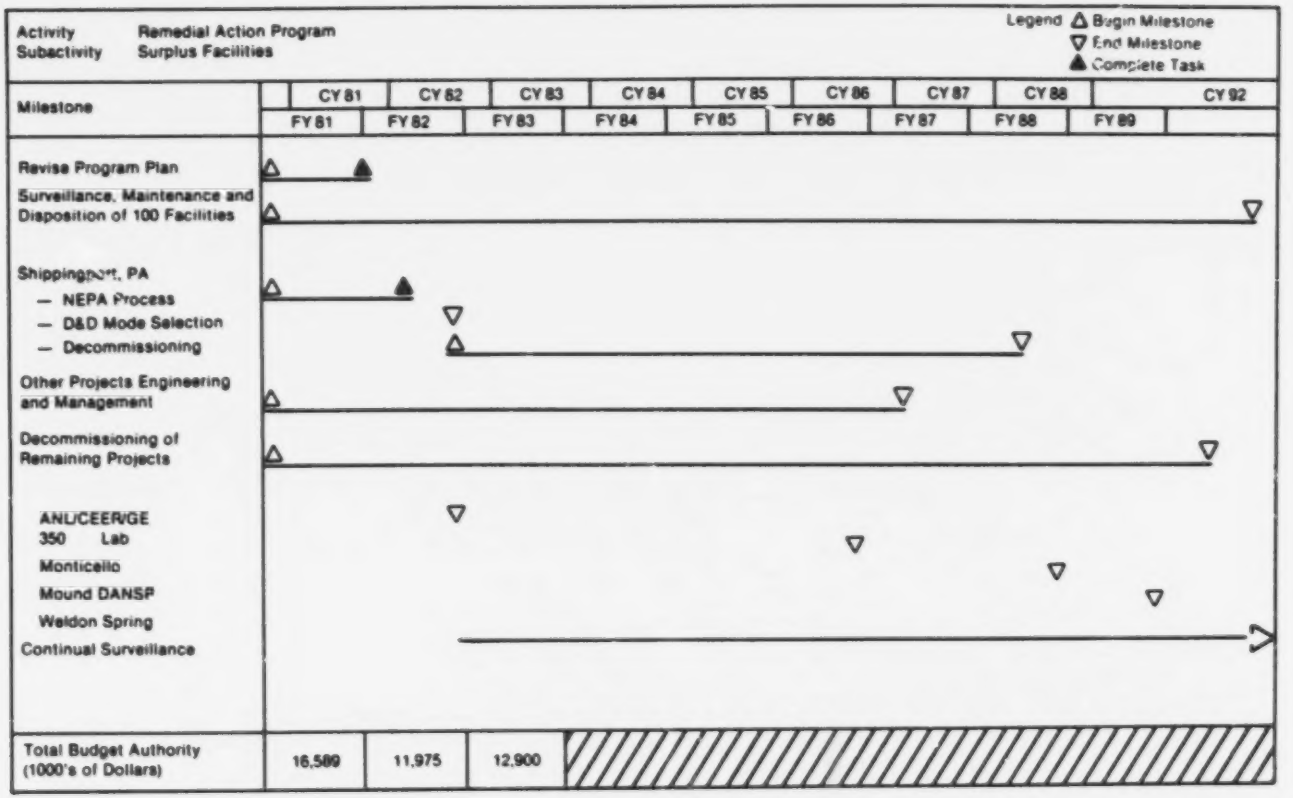

FIGURE 5-14
D&D SURPLUS FACILITIES MILESTONE SCHEDULE

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6.0 Program Management

The Department of Energy's Nuclear Waste Management and Fuel Cycle Programs Office reports to the Assistant Secretary for Nuclear Energy. The organization of the program office is shown in Figure 6.1. Day-to-day execution of the programs is assigned to Department field offices and they are executed through their contractors. Policy and overall budget priorities are established by Headquarters, which gives appropriate direction to the field. Headquarters subsequently monitors the field office and contractor activities. Nuclear Waste Management and Fuel Cycle Programs coordinates its Headquarters and field activities with other Federal agencies, state and local governments, industry, universities, and public interest groups as appropriate.

At the direction of Congress, the Commercial and Defense related activities within DOE were separated into different organizational elements effective in 1981. A memorandum of understanding for sharing of technical and programmatic information has been implemented.

All nuclear waste management and fuel cycle projects have primary field offices assigned to provide day-to-day management. Formal management agreements have been or are being established between Headquarters and specific field operations offices to establish arrangements for execution of projects. These agreements cover purpose, program direction, organization, responsibilities of key officials and participants, and the authorities of the participants.

More specifically, the roles and responsibilities at Headquarters and operations offices are as follows:Nuclear Waste Management and Fuel Cycle Programs (Headquarters)

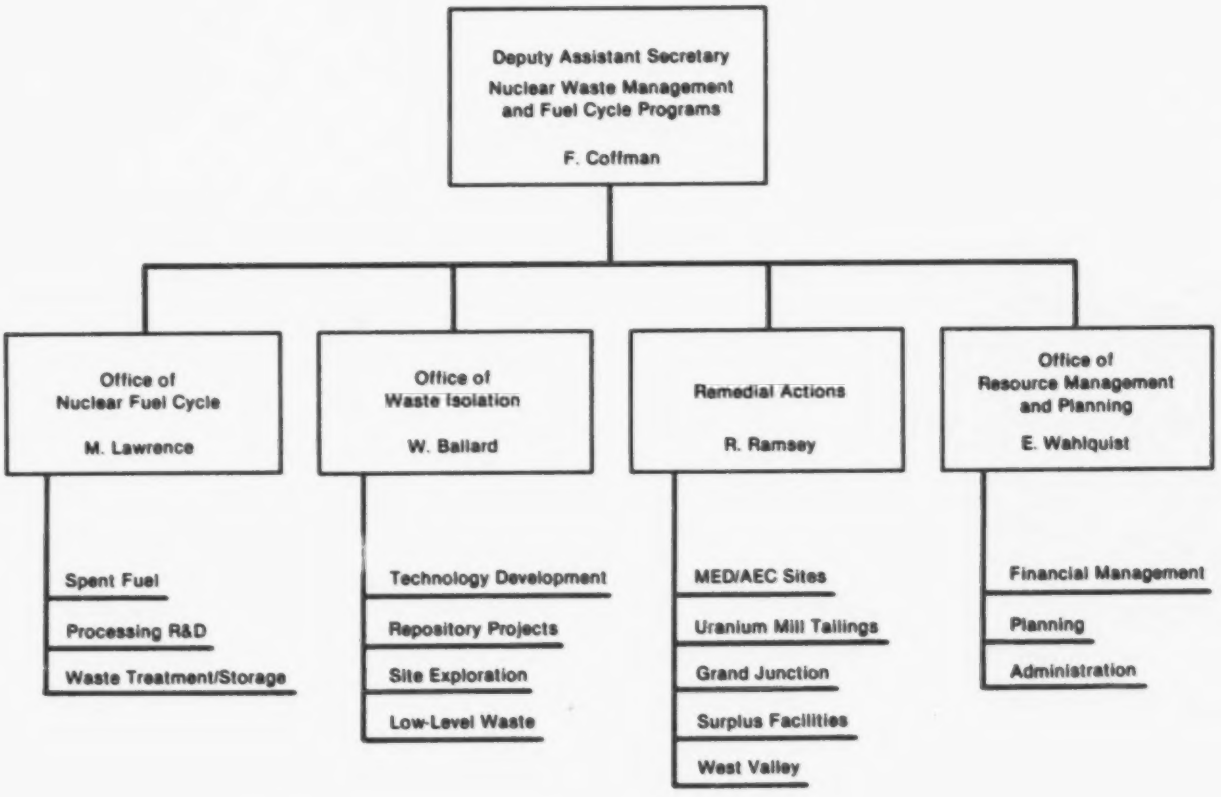

FIGURE 6-1
ORGANIZATION STRUCTURE

- Within the policy guidance provided by the Assistant Secretary for Nuclear Energy (ASNE) for Commercial Nuclear Waste and Fuel Cycle programs, interprets policies and develops strategic and program plans encompassing scientific and technical activity content, goals, and objectives (including environmental and safety requirements).
- Interacts, as appropriate, with the DOE's staff organizations and other Federal agencies.
- Develops and defines budget requirements and defends budget requests to the Office of Management and Budget (OMB) and Congressional committees as appropriate.
- Provides general policy guidance and technical direction to field offices and contractor organizations (shown in Table 6.1).
- Monitors technical and programmatic progress, initiates programmatic reviews, evaluates results, and modifies program direction within the limits defined by ASNE for Commercial Nuclear Waste and Fuel Cycle programs.

Operations Offices

- Manage projects with full authority in accord with management plan approved by Headquarters.
- Provide day-to-day management of projects with feedback to Headquarters.
- Perform contract administration and other activities incidental to project management.
- Direct contractors in financial and technical matters.

Contractors (National Laboratories, Universities, and Industry)

- Initiate proposals or respond to requests for proposals.
- Assist in the development of strategic activity plans.
- Execute the technical program within the guidance provided by DOE.

Table 6-1
Nuclear Waste Management and Fuel Cycle Programs — Program/Project Assignment

Program Element	*Primary Field Office*	*Principal Contractor*
Commercial Waste Management		
Terminal Isolation	Headquarters	—
ONWI	Chicago	Battelle
Basalt	Richland	Rockwell
Nevada	Nevada	Sandia Nat'l. Lab.
Subseabed	Albuquerque	Sandia Nat'l. Lab.
Waste Systems Technology		
Federal/State Interactions	Chicago	—
Supporting Studies	Headquarters	Pacific Northwest Lab.
Low-Level Waste Technology	Idaho	EG&G
West Valley	Headquarters	Westinghouse
Remedial Actions		
MED/AEC Sites	Oak Ridge	Bechtel
Grand Junction	Grand Junction	State of Colorado
Mill Tailings	Albuquerque	Jacobs Engineering
Surplus Agency Facilities	Richland	United Nuclear Ind.
Nuclear Fuel Cycle		
Spent Fuel Technology	Richland	Pacific Northwest Lab.
Fuel Reprocessing R&D		
Advanced Fuel Reprocessing	Oak Ridge	Oak Ridge Nat'l. Lab.
Barnwell	Richland	Allied Gulf Nuclear Serv.
Proof of Breeding	Chicago	Argonne Nat'l. Lab.
Waste Treatment and Storage Technology		
Airborne Waste Technology	Oak Ridge	Oak Ridge Nat'l. Lab.
High Level & TRU Waste Technology	Richland	Pacific Northwest Lab.
Landlord (Pacific Northwest Laboratory)	Richland	Pacific Northwest Lab.

APPENDIX A

PRESIDENT REAGAN'S POLICY STATEMENT

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release October 8, 1981

STATEMENT BY THE PRESIDENT

A more abundant, affordable, and secure energy future for all Americans is a critical element of this Administration's economic recovery program. While homeowners and business firms have shown remarkable ingenuity and resourcefulness in meeting their energy needs at lower cost through conservation, it is evident that sustained economic growth over the decades ahead will require additional energy supplies. This is particularly true of electricity, which will supply an increasing share of our energy.

If we are to meet this need for new energy supplies, we must move rapidly to eliminate unnecessary government barriers to efficient utilization of our abundant, economical resources of coal and uranium. It is equally vital that the utilities — investor-owned, public, and co-ops — be able to develop new generating capacity that will permit them to supply their customers at the lowest cost, be it coal, nuclear, hydro, or new technologies such as fuel cells.

One of the best potential sources of new electrical energy supplies in the coming decades is nuclear power. The U.S. has developed a strong technological base in the production of electricity from nuclear energy. Unfortunately, the Federal Government has created a regulatory environment that is forcing many utilities to rule-out nuclear power as a source of new generating capacity, even when their consumers may face unnecessarily high electric rates as a result. Nuclear power has become entangled in a morass of regulations that do not enhance safety but that do cause extensive licensing delays and economic uncertainty. Government has also failed in meeting its responsibility to work with industry to develop an acceptable system for commercial waste disposal, which has further hampered nuclear power development.

To correct present government deficiencies and to enable nuclear power to make its essential contribution to our future energy needs, I am announcing today a series of policy initiatives:

(1) I am directing the Secretary of Energy to give immediate priority attention to recommending improvements in the nuclear regulatory and licensing process. I anticipate that the Chairman of the Nuclear Regulatory Commission will take steps to facilitate the licensing of plants under construction and those awaiting licenses. Consistent with public health and safety, we must remove unnecessary obstacles to deployment of the current generation of nuclear power reactors. The time involved to proceed from the planning stage to an operating license for new nuclear power plants has more than doubled since the mid-1970s and is presently some 10-14 years. This process must be streamlined, with the objective of shortening the time involved to 6-8 years, as is typical in some other countries.

(2) I am directing that government agencies proceed with the demonstration of breeder reactor technology, including completion of the Clinch River Breeder Reactor. This is essential to ensure our preparedness for longer-term nuclear power needs.

(3) I am lifting the indefinite ban which previous Administrations placed on commercial reprocessing activities in the United States. In addition, we will pursue consistent, long-term policies concerning reprocessing of spent fuel from nuclear power reactors and eliminate regulatory impediments to commercial interest in this technology, while ensuring adequate safeguards.

It is important that the private sector take the lead in developing commercial reprocessing services. Thus I am also requesting the Director of the Office of Science and Technology Policy, working with the Secretary of Energy, to undertake a study of the feasibility of obtaining economical plutonium supplies for the Department of Energy by means of a competitive procurement. By encouraging private firms to supply fuel for the breeder program at a cost that does not exceed that of government-produced plutonium, we may be able to provide a stable market for private sector reprocessing, and simultaneously reduce the funding needs of the U.S. breeder demonstration program.

(4) I am instructing the Secretary of Energy, working closely with industry and state governments, to proceed swiftly toward deployment of means of

storing and disposing of commercial high-level radioactive waste. We must take steps now to accomplish this objective and demonstrate to the public that problems associated with management of nuclear waste can be resolved.

(5) I recognize that some of the problems besetting the nuclear option are of a deep-seated nature and may not be quickly resolved. Therefore, I am directing the Secretary of Energy and the Director of the Office of Science and Technology Policy to meet with representatives from the universities, private industry and the utilities and requesting them to report to me on the obstacles which stand in the way of increased use of nuclear energy and the steps needed to overcome them in order to assure the continued availability of nuclear power to meet America's future energy needs not later than September 30, 1982.

Eliminating the regulatory problems that have burdened nuclear power will be of little use if the utility sector cannot raise the capital necessary to fund construction of new generating facilities. We have already taken significant steps to improve the climate for capital formation with the passage of my program for economic recovery. The tax bill contains substantial incentives designed to attract new capital into industry.

Safe, commercial nuclear power can help meet America's future energy needs. The policies and actions that I am announcing today will permit a revitalization of the U.S. industry's efforts to develop nuclear power. In this way, native American genius — not arbitrary federal policy — will be free to provide for our energy future.

THE PRESIDENTIAL STATEMENT ON NUCLEAR POWER

Department of Energy Fact Sheet Assistant Secretary for Nuclear Energy

October 8, 1981

Introduction

The President's Statement released today sets forth the basic elements of the Administration's policy regarding nuclear energy. It recognizes the importance of increased energy supplies to support future economic growth. Electrical energy is now an essential source and will become an expanding component of our total energy requirements.

Historically, the growth rate of electricity demand has outpaced the economic growth rate. Even though this relationship has narrowed in the 1970s, most forecasters still project electricity demand to grow at a faster rate than the economy as a whole and expect it to play a significant role in bringing about the productivity gains necessary to expand the nation's wealth. All of which points to the importance of an adequate supply of electricity in the 1980s and beyond. Uranium, with coal, is one of the two principal domestic resources capable of supporting the electrical expansion necessary to satisfy economic growth and decreasing reliance on foreign energy supplies.

Currently, about 48 percent of electricity generation is by coal with about 12 percent by nuclear. A more balanced contribution would add flexibility and security to our supply. As the nuclear capability expands, it should take over a larger proportion of the generation of electricity while freeing coal for some of its many other applications such as the raw material for synthetic oil and gas. Current Department of Energy data show that the cost of electricity generated by nuclear power is equal to or less than electricity using coal in most regions of the United States. And latest Department projections indicate that nuclear power will maintain its cost advantage through the 1980s and 90s.

Today's Problem

The decade spanning the last half of the 1960s and early 1970s saw a rapid and sustained growth in utility commitments to nuclear power. Over this period, an average of 16 new plants were ordered annually, with a peak of 30 new plant orders in 1967 and 24 orders in 1973.

However, the electric utility industry, as it exists today, is at a standstill. We now have a situation whereby there have been no new nuclear plant orders in the last three years. In addition, a steadily mounting number of previously ordered plants have been cancelled.

In essence the U.S. nuclear program has clearly lost the forward momentum which characterized the earlier years. The current status can be summarized as follows:

- the LWR option, the first commercialized nuclear enterprise in the U.S., has been severely handicapped by institutional paralysis — a combination of financial and regulatory factors;
- three attempts at commercial reprocessing have been unsuccessful, for both technical and institutional reasons;
- the Federal Government has yet to fulfill its responsibility to provide timely disposal services for high level nuclear wastes;
- the U.S. breeder development program has lost its previous impetus and is now substantially behind that of other nations;
- the U.S. Government is perceived as an unreliable partner with industry and an unreliable supplier of nuclear technology abroad.

National Goal

The first requirement to give renewed momentum to the U.S. nuclear energy program is to stabilize nuclear policy for periods of time commensurate with the long lead times characteristics of nuclear technology. Clear, decisive and sustained leadership and support is required from government officials. In this area, we have made notable progress. President Reagan's nuclear policy statement, which clearly details his support of nuclear power, will help create a national resolve toward allowing nuclear energy to realize its potential.

The Department of Energy's Nuclear Program Strategy Elements

The four fundamental elements of a nuclear strategy to achieve the full potential of fission energy's contribution to electrical energy supply are: converter reactor deployment, spent fuel reprocessing, immobilization and disposal of high level wastes, and breeder reactor development and ultimate deployment. These basic elements and their relationships are shown schematically on the attached chart.

The Federal Government has clear responsibility for two areas that are integral to the future role of nuclear power: (1) proper disposal of radioactive wastes, and (2) development of breeder technology to a point where timely commercialization is feasible. There is no question that technically acceptable means of disposal exist and that they can be demonstrated. The Administration's program of breeder reactor demonstration, which contemplates the reprocessing of spent fuel by the private sector, reflects a similar commitment. With private sector cooperation, the breeder program provides the necessary focus to maintain this potentially important supply option for the future.

The role of DOE in the further deployment of Light Water Reactors and in the commercial reprocessing of LWR fuel is one of removing current institutional, regulatory and financial obstacles. This would include such items as streamlining of the reactor licensing process, working to improve the utility financial condition, initiating a nuclear public information program, and providing a stable government/industry institutional arrangement for a commercial reprocessing venture.

With this overall framework in mind, the DOE actions to support the specific policy objectives and program initiatives of the President are detailed below.

PRESIDENTIAL STATEMENT OVERVIEW

As noted in the President's Nuclear Policy Statement, Federal obstacles to a healthy nuclear industry have included:

- unnecessary regulations that do not enhance safety but cause extensive licensing delays and economic uncertainties;
- the absence of an operating system for disposal of commercial nuclear waste; and
- frustration of private sector development and deployment of reprocessing technology.

Continuation of these practices would effectively foreclose expansion of the nuclear option, with the possible results of:

- electricity shortfalls;
- higher than necessary power costs;
- the need to import nuclear technology from abroad; and
- loss of U.S. ability to influence the policies of other nations in preventing the further proliferation of nuclear weapons.

To address these concerns, the President's statement identifies three major areas of required activity:

- the determination and the removal of excessive regulatory and institutional barriers to fuller utilization of nuclear energy;
- continued long-term research and development in areas such as breeder reactors; and,
- deployment of means of storing and disposing of radioactive waste.

Policy Objectives of the President's Statement

To correct these deficiencies and to enable nuclear power to make its essential contribution to our future energy needs, the President announced a series of policy objectives and program initiatives:

1. **The Secretary of Energy, in conjunction with the Vice President's Task Force on Regulatory Relief, will seek to improve the nuclear regulatory and licensing process.**

The licensing process must be streamlined and disciplined, and DOE will play a role in this effort. There is no valid reason why reactor lead times in the U.S. must be so long and unpredictable, varying between 10 and 15 years, when plants in France and Japan can be licensed and constructed in much less time. The utilities and their investors simply cannot cope with such uncertainties. Key actions by the Department of Energy to support the President's program are to:

- recommend changes to licensing regulations by December 1, 1981; and
- explore approaches for decreased plant costs and construction times during FY 1982-83.

These actions, coupled with steps to be taken by the Nuclear Regulatory Commission to facilitate the licensing of plants under construction and awaiting licenses, are intended to remove unnecessary obstacles to the timely deployment of light water reactors.

2. **Development and demonstration of breeder reactor technology, including construction and operation of the Clinch River Breeder Reactor, will proceed.**

Development of the breeder reactor is an example of the type of research and development expected from the government in the nuclear area. Breeder technology can obtain 60 times as much energy from the same amount of uranium as is generated by the light water reactors in use today. The U.S. now has in storage enough uranium to provide U.S. electrical requirements for several hundred years if used in breeder reactors. Beyond that, the uranium resource base left in the ground could fulfill our requirements for thousands of years. A domestic energy supply of this magnitude holds enormous implications for our future energy stability and our national security.

This represents a major departure from the previous Administration's position of attempting to put breeder technology on hold and to cancel the Clinch River Breeder Reactor (CRBR) project. The new policy returns to a sequence of carefully scaled plant projects as the central line of advance for the breeder program. The strategy for engineering scale-up proceeds from Experimental Breeder Reactor-II to the Fast Flux Test Facility, to the CRBR and finally to a Large Developmental Plant (LDP) which will be at or near commercial plant size.

The scaling-up process pertains not only to overall plant size but to proportionately incremental increases in major components as well. This is a disciplined, cost-effective, high-confidence strategy consistent with the best engineering practices in industry. A base technology program will support the plant projects to decrease technical risks in their design, construction, and operation. Concurrently, a fuel cycle program will develop equipment and concepts needed to meet the unique requirements of reprocessing LMFBR fuels. Financial and institutional arrangements will be examined with an objective of maximizing the participation of the utilities and industry. This development strategy will provide the basis for eventual development and deployment of the breeder by the private sector.

The CRBR Project is severely off baseline schedule due to the policy debate of the past four years. Near-term efforts will focused on review of all aspects of the project — management structure, schedule, cost, project technical objectives, and licensing activity — with an aim toward streamlining and fast-tracking the project.

We will also accelerate the design and institutional planning for a larger project beyond CRBR, the Large Developmental Plant. Pressures to reduce Federal expenditures on energy development and production make it unlikely that a follow-on plant will be a predominantly Government undertaking. Hence, innovative financial and institutional arrangements will be examined with an objective of maximizing the participation of the utilities and industry. Key milestones of the Department are to:

- accelerate the CRBR Project with the objective of achieving criticality in the late 1980's;
- complete institutional and financial planning with industry for the LDP by January 1983;
- operate Breeder Fuel Fabrication Facility - 1986; and,
- prepare to commit to Breeder Reprocessing Facility by 1984.

3. **The indefinite ban on commercial reprocessing will be lifted.**

Spent fuel reprocessing, first developed here and currently in practice in six other countries, does not now exist in the U.S. Three government encouraged attempts at commercial reprocessing — West Valley, Morris, and Barnwell — have failed. In two of these cases, West Valley and Barnwell, the failures are traceable to unstable federal regulatory and development policy. Our course of action must be to return to a fuel cycle policy that includes reprocessing.

President Reagan believes that spent fuel storage and reprocessing can, and should, be managed by private sector interests. He has directed that major regulatory and policy barriers that have contributed to the failure of commercial reprocessing in the past be identified and resolved with the intention of creating a more favorable climate for private sector reprocessing. Key initiatives of the Department are:

- consult with industry to identify barriers to commercial reprocessing and make recommendations for improving the climate for private reprocessing; and
- foster the development of a national reprocessing capability by 1989.

4. **The Secretary of Energy, in conjunction with industry, will swiftly deploy means of storing and disposing of radioactive waste.**

The government accepts full responsibility for permanent isolation of high-level radioactive wastes. This is an issue that must be resolved if we are to gain the public acceptance that is so necessary to nuclear growth. Contrary to a sizable fraction of public belief, we already have the technology in hand or under development for safe disposal of nuclear waste. The Department of Energy is focusing its program toward an early R&D demonstration of high-level waste storage on a retrievable and monitored basis, in the ground. We believe this will go a long way toward engendering public confidence in our waste management capabilities.

The previous Administration's approach of using spent fuel as the preferred waste form is technically achievable; however, reprocessed waste results in a more desirable waste form from the standpoint of long-term stability. It is our intent to demonstrate the permanent isolation of reprocessed high-level radioactive wastes as soon as possible.

Reprocessing is key to the formulation of our high level waste program. By separating out the principal long-term concern — certain isotopes of plutonium, converting the waste to a solid form and then placing it in a very stable, immobilized form, such as glass, it will be demon-

strated that we can effectively handle radioactive waste and prepare it for permanent isolation.

The temporary storage of such solidified wastes at or below the earth's surface will lend further credence to availability of an effective solution. It could also serve as a valuable contingency plan should difficulties occur in development of an acceptable permanent repository. Key Departmental milestones are to:

- complete conceptual design of an interim retrievable storage facility (for immobilized HLW)
- identify as part of the permanent geological repository program, three specific sites at which construction on exploratory shafts to depth would begin by 1983, to be completed by 1985. Three locations will likely be: in basalt flows on the Hanford site; in welded volcanic tuff on the Nevada Test Site; and in a salt formation site to be determined by 1983;
- following examination of the three sites at depth, select one of the three sites for the development of a test and evaluation facility. This is currently scheduled for 1985;
- continue parallel work on detailed site characterization, necessary before a decision can be made on determining the sites or site to be used for a full-scale permanent licensed repository, at all three sites;
- emplace radioactive waste in the test and evaluation facility in 1989; and
- submit a license application to NRC for the first repository in 1988.

Summary and Conclusions

To summarize, it is proposed that industry and the Federal Government focus sharply on a few large national objectives for nuclear power:

- to remove institutional and regulatory impediments constraining the continued deployment of commercial nuclear power reactors;
- to proceed deliberately and swiftly to fulfill the Federal Government's responsibility to safely dispose of high-level wastes;
- to stabilize Government policy concerning reprocessing of light water reactor spent fuel and to attract renewed commercial interest in this technology;
- to proceed to scale up breeder technology to unit sizes of commercial applicability; and,
- to restore U.S. credibility and strength in international nuclear commerce.

Our priority goal must be to stabilize nuclear policy for periods of time commensurate with the long leadtimes characteristics of nuclear technology. The U.S. Government role should be to create and sustain a policy environment in which long-term objectives beneficial to the Nation can be achieved primarily by the private sector.

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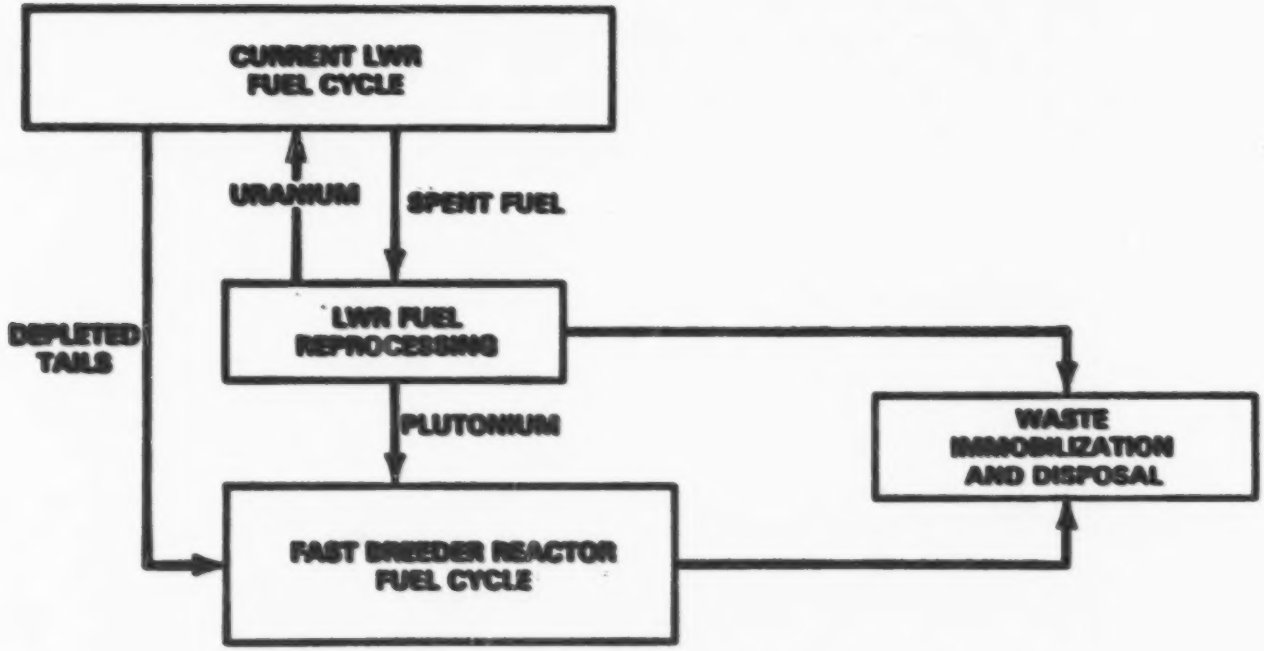
THE COMPLETE FISSION ENERGY SYSTEM



APPENDIX B

PROGRAM PARTICIPANTS AND BUDGET

PROGRAM PARTICIPANTS

DOE contractors include a variety of technical and scientific organizations such as the National Laboratories, universities, and private industry. These contractors carry out the research and development, assist in planning, and actually construct and operate government facilities, under the direction of DOE.

The Nuclear Waste Management and Fuel Cycle Programs have been divided into four major segments as follows:

- Nuclear Fuel Cycle Program
- Commercial Waste Management Program
- Remedial Action Program
- Nuclear Waste Disposal Fund

BUDGET

Tables B-1 through B-8 present the budgets for each of these segments for fiscal years 1981, 1982, and 1983. The odd numbered tables provide a breakdown of the budget for each program segment by major activity. The even numbered tables show the laboratories that are involved in each program segment and their budgets for operations, capital, and construction expenses associated with each program segment.

Table B-1
Nuclear Fuel Cycle Program
($ in Millions)

	FY 1981	*FY 1982*	*FY 1983*
Spent Fuel	20.0	6.8	6.9
Fuel Reprocessing	47.5	36.5	35.6
Waste Treatment	14.3	7.3	15.6
Program Direction	1.0	1.1	1.2
Total	82.8	51.7	59.3

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Table B-2
Nuclear Fuel Cycle Program Budget[a] for Laboratories/Contractors

Contractors	1981 Op	1981 Cap	1981 Con[b]	1982 Op	1982 Cap	1982 Con[b]	1983 Op	1983 Cap	1983 Con[b]
Energy Technology Laboratories and National Laboratories									
Argonne National Laboratories	6,406	526	0	5,941	100	0	3,900	100	0
Hanford Engineering Development Laboratory	130	0	0	0	0	0	0	0	0
Idaho National Engineering Laboratory	685	0	0	0	0	0	0	0	0
Lawrence Livermore Laboratory	0	130	0	100	0	0	0	0	0
Los Alamos National Laboratory	1,344	450	0	488	0	0	925	0	0
Oak Ridge National Laboratory	21,602	4,980	0	20,403	3,100	0	18,600	3,000	0
Pacific Northwest Laboratory	3,005	2,220	1,500	1,185	1,105	1,100	0	1,200	1,200
Sandia Laboratory	1,175	176	0	20	0	0	0	0	0
Savannah River Laboratory	5,305	903	0	35	0	0	0	0	0
Program Dedicated Laboratories									
Mound Laboratory	-80	0	0	163	0	0	0	0	0
Production, Testing and Fabrication Facilities									
ICPP, Idaho	596	0	0	0	0	0	0	0	0
Nevada Test Site	50	0	0	0	0	0	0	0	0
Rockwell Hanford, Richland	0	65	0	0	165	0	0	0	0
Rocky Flats Plant	3	0	0	477	0	0	0	0	0
All other contractors	21,127	500	10,000	15,740	1,590	0	29,350	1,000	0
Totals	61,348	9,950	11,500	44,552	6,060	1,100	52,775	5,300	1,200

a) Given in thousands of dollars B/A FY81 Actual/FY82 Estimate/FY83 Request
b) Operating Expenses/Capital Equipment/Construction

Table B-3
Commercial Waste Management Program
($ in Millions)

	FY 1981	FY 1982	FY 1983
Terminal Isolation Program	173.3	187.9	50.4
Waste Systems Technology	8.6	8.9	11.4
West Valley	5.0	9.9	15.4
Program Direction	1.9	2.6	3.3
Total	188.8	209.3	80.5

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Table B-4
Commercial Waste Management Program Budget[a] for Laboratories/Contractors

Contractors	1981 Op	1981 Cap	1981 Con[b]	1982 Op	1982 Cap	1982 Con[b]	1983 Op	1983 Cap	1983 Con[b]
Energy Technology Laboratories and National Laboratories									
Argonne National Laboratories	1,269	94	0	2,442	0	0	0	0	0
Brookhaven National Lab	0	29	0	0	0	0	0	0	0
Hanford Engineering Development Center	267	50	0	315	0	0	315	0	0
Idaho National Engineering Laboratory	1,292	0	0	14,181	300	0	18,875	1,450	0
Lawrence Berkeley Laboratory	0	632	0	455	0	0	0	0	0
Lawrence Livermore Laboratory	0	71	0	355	0	0	0	0	0
Los Alamos National Laboratory	0	82	0	265	0	0	0	0	0
Oak Ridge National Laboratory	435	172	0	1,381	0	0	250	0	0
Pacific Northwest Laboratory	1,172	1,026	0	6,357	0	0	0	0	0
Sandia Laboratory	7,450	990	0	5,260	940	0	7,000	1,500	0
Savannah River Laboratory	0	20	0	20	0	0	0	0	0
Production, Testing and Fabrication Facilities									
Rockwell Hanford, Richland	31,483	1,400	3,576	29,865	2,000	0	0	0	0
Nevada Test Site	27,500	3,198	0	43,380	2,000	0	2,000	0	0
Office of Nuclear Waste Isolation	90,401	0	0	74,073	0	0	34,650	0	0
All Other Contractors	15,418	236	500	21,718	4,077	0	7,199	5,250	2,000
Totals	176,687	8,000	4,076	200,067	9,317	0	70,289	8,200	2,000

a) Given in thousands of dollars B/A FY81 Actual/FY82 Estimate/FY83 Request
b) Operating Expenses/Capital Equipment/Construction

Table B-5
Remedial Action Program
($ in Millions)

	FY 1981	FY 1982	FY 1983
MED/AEC Sites	11.0	11.2	12.0
Grand Junction	2.0	1.7	1.8
Mill Tailings	13.2	18.2	23.2
Surplus Facilities	16.6	12.0	12.9
Program Direction	0.3	0.3	0.4
Total	43.1	43.4	50.3

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Table B-6
Remedial Action Program Budget[a] for Laboratories/Contractors

Contractors	1981 Op	1981 Cap	1981 Con[b]	1982 Op	1982 Cap	1982 Con[b]	1983 Op	1983 Cap	1983 Con[b]
Energy Technology Laboratories and National Laboratories									
Argonne National Laboratories	3,824	150	0	2,432	0	0	1,270	235	0
Idaho National Engineering Laboratory	470	38	0	0	0	0	0	0	0
Lawrence Berkeley Laboratory	335	0	0	325	0	0	550	0	0
Los Alamos National Laboratory	303	0	0	675	70	0	200	0	0
Oak Ridge National Laboratory	2,401	15	0	634	0	0	780	0	0
Pacific Northwest Laboratory	2,995	0	0	1,290	0	0	1,090	120	0
Sandia Laboratory	1,520	0	0	4,656	0	0	1,940	50	0
Program Dedicated Laboratories									
Mound Laboratory	1,700	0	0	3,300	0	0	3,540	0	0
Production, Testing and Fabrication Facilities									
Rockwell Hanford, Richland	456	0	0	0	0	0	0	0	0
United Nuclear Corp, Richland	394	0	0	2,280	0	0	2,320	0	0
All other contractors	23,622	847	4,000	27,062	705	0	37,210	995	0
Totals	38,020	1,050	4,000	42,654	775	0	48,900	1,400	0

a) Given in thousands of dollars B/A FY81 Actual/FY82 Estimate/FY83 Request
b) Operating Expenses/Capital Equipment/Construction

Table B-7
Nuclear Waste Disposal Fund
($ in Millions)

	FY 1981	FY 1982	FY 1983
Nuclear Waste Disposal Fund	$ 0	$ 2	$185.0

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Table B-8
Nuclear Waste Disposal Fund Budget[a] for Laboratories/Contractors

Contractors	*1981*		*1982*		*1983*	
	Op	*Cap*[b]	*Op*	*Cap*[b]	*Op*	*Cap*[b]
Production, Testing and Fabrication Facilities:						
Rockwell Hanford, Richland	0	0	0	0	49,700	1,300
Nevada Test Site.....	0	0	0	0	56,700	3,800
Office of Nuclear Waste Isolation	0	0	0	0	73,250	0
All Other Contractors.....	0	0	0	0	0	250
Total	0	0	0	0	179,650	5,350

a) Given in thousands of dollars B/A FY81 Actual/FY82 Estimate/FY83 Request
b) Operating Expenses/Capital Equipment

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APPENDIX C

INTERNATIONAL PROGRAMS FOR RADIOACTIVE WASTE MANAGEMENT

INTERNATIONAL PROGRAMS

Cooperative international programs related to nuclear energy serve key U.S. foreign policy objectives and assist in the advancement of domestic energy programs. Participation in these cooperative programs serves to:

- Provide an improved basis for negotiating and using bilateral technology exchange agreements with other countries.
- Maximize the benefits of U.S. participation in international programs, committee meetings, and conferences.
- Contribute to the base for systems evaluations.
- Improve plans for U.S. research, development and demonstration programs.
- Minimize waste management research and development expenditures of participating nations by eliminating duplications.
- Help establish an internationally accepted technological basis for waste conditioning processes and waste disposal criteria and methods.

The U.S. is signatory to a number of bilateral and multilateral cooperative agreements which deal with the issues of nuclear power and radioactive waste. These range from information exchanges to detailed cooperative projects. In addition, the U.S. is party to a number of international treaties and conventions and actively participates in or coordinates with a number of international agencies. Some of these treaties and agencies include:

- The International Treaty on the Nonproliferation of Nuclear Weapons
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The London Convention)
- The International Atomic Energy Agency
- The European Atomic Energy Committee (EURATOM)

International Activities Specific to Radioactive Waste Management

A number of nations are involved with waste management research and development activities which complement or duplicate similar U.S. activities. The conclusions of these programs have, in many instances, been similar to those of U.S. programs. They have also been used in developing and modifying U.S. program activities. The major countries involved in waste management research and development and their involvement in international waste handling and isolation activities are presented in Table C-1.

International programs for geologic waste isolation research, waste conditioning activities, airborne wastes, and transuranic waste incineration have been summarized as follows:

- Research on geologic waste isolation is of interest to the defense and commercial programs. Topics that have been studied from a different perspective than that of U.S. scientists which are of particular interest are isotopic pathway analysis, hydrologic modeling, rock properties, heat transfer, and design criteria related to granite, shale, salt, and basalt. Data concerning isotope migration through clay formations have been extensively studied by other countries and are also useful to U.S. programs. (See Table C-2).

- A significant part of the radioactive waste activity is directed to the selection and characterization of acceptable waste forms and the development and demonstration of production-scale waste immobilization processes. The major waste conditioning activities performed by foreign countries and agencies are presented in Table C-3. Advanced HLW vitrification programs exist in the Federal Republic of Germany, France, Belgium, the United Kingdom, India, and Japan. The physics and chemistry of glasses and other waste forms under long-term geologic exposure are also being studied by countries under international cooperative agreements.

- The U.S. program on airborne wastes would benefit from cooperative development of separation and immobilization methods for tritium, krypton, iodine, and carbon-14 since complete technology packages (or systems) do not exist for all of these purposes. The

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Table C-1
Major Waste Handling and Isolation By Country

	Activity						
Country	*Transportation*	*Interim Storage*	*Shallow Land Burial*	*Geologic Isolation*	*Seabed Isolation*	*Airborne Waste Immobilization*	*Safety/Risk Analysis*
Austria				x			x
Belgium	x	x		xx		x[a]	x
Canada		xx		xx	xx	x	x
Denmark				x			
France	xx	x	x	xx	xx	x	xx
Federal Republic of Germany	xx	xx		xx		xx	xx
India				x			x
Ispra (CEC)							xx[b]
Italy				x			
Japan	xx	x	xx	xx	xx	xx	xx
Netherlands				x	x		x
Spain		x		x			
Sweden	x	x		x			x
Switzerland		x		x	x		x
United Kingdom	x	x	x	x	xx	xx	xx
USSR	x	x	x	x			x

x = R&D activities underway
xx = U.S. interest in cooperative program is already identified

a. Eurochemic/NEA Program—Mol, Belgium
b. Joint Research Centre of CEC—Ispra, Italy

Source: *Nuclear Waste Management: Program Summary Document, FY 1981*. Assistant Secretary for Nuclear Energy, Office of Nuclear Waste Management, DOE/NE-0008, Draft. U.S. Department of Energy. 1980.

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Table C-2
Geologic Waste Isolation Research Activities in Foreign Countries

Nation	*Waste Type*	*Formations of Interest*	*Current Studies*	*Milestones*
Austria	Spent fules Miscellaneous wastes	Hard rock	General studies Safety assessment	
Belgium	HLW Non-HLW	Clay beds	Site evaluation Clay-bed properties In-situ studies—tunnel	Test repository at Mol — 1983
Canada	Spent fuels HLW Non-HLW	Plutonic rocks	Site evaluation In-situ studies—Granite test site (Small effort on bedded salt formations)	Underground Research Laboratory — 1985-1986 Concept verification for repository — 1990
Denmark	Non-HLW	—	Geologic survey	—
France	Alpha wastes	Crystalline rocks	Geologic survey Safety assessment (Small effort on rock salt)	Pilot plant repository (alpha wastes) — 1985
Germany (East)	Non-HLW	Salt	LLW disposal at Bartensleben	—
Germany (West)	Spent HTGR fuels Non-HLW HLLW	Salt Hard rock (Konrad mine)	Salt mine R&D—Asse mine Safety assessment Engineering for spent fuel and HLW storage	Complete site characterization at Gorleben — 1985 Gorleben repository — 1995 Konrad iron mine repository (LLW) — 1985
India	HLW Non-HLW	Igneous rock Sediments	Sites evaluation Properties of rocks	—
Ireland	Non-HLW	—	Geologic survey	—
Italy	HLW	Clay Salt	Geologic survey In-situ studies in clay beds	Pilot plant repository — mid-1980's
Japan	HLW	Disbase Zeolotic tuff Granite	Geologic survey Safety assessment	Selection of candidate formations — 1985; startup of disposal site — after 2015
Netherlands	Non-HLW	Salt	Geologic survey Safety assessment	—
Spain	HLW Non-HLW	Shale Clay Salt	Non-HLW going into old uranium mines Site evaluation	Pilot plant repository — late 1980's
Sweden	Spent fuels HLW Non-HLW	Hard rock (granite)	Field tests—Strips mine Safety assessment	Repository for reactor wastes — 1989; HLW repository site selection — 2000
Switzerland	HLW Non-HLW	Granite	Site evaluation Safety assessment HLW test site development	Field laboratory (granite) — 1982; repository — 2020
United Kingdom	—	Crystalline rock Clay	Safety assessment	—
USSR	Non-HLW	Varied	Direct injection underground	—
CEC	HLW	—	Support work in Belgium & Italy (clay), Federal Republic of Germany (salt), United Kingdom and France (crystalline rock)	—

Source: *Nuclear Waste Management: Program Summary Document, FY 1981*. Assistant Secretary for Nuclear Energy, Office of Nuclear Waste Management, DOE/NE-0008. Draft. U.S. Department of Energy. 1980.

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Table C-3
Major Waste Conditioning Activities By Country and Agency

Country	Activity: HLW Conditioning	HLW Form Characterization	Spent Fuel Packaging	LLW and Intermediate Waste Conditioning	TRU Waste Conditioning
Australia	xx	xx			
Austria				x	
Belgium and Eurochemic	x[a]	xx[aa]		xx[a]	xx[a]
Canada	x	x	xx	x	
France	xx	xx		xx	xx
Federal Republic of Germany	xx	xx	x	xx	xx
India	x	x		x	x
Ispra (CEC)		xx[b]			x[b]
Italy	x	x		x	x
Japan	xx	xx		xx	xx
Sweden	x	x	xx	x	
United Kingdom	x	xx		x	xx

x = R&D activities underway
xx = U.S. interest in cooperative program is already identified

a. Eurochemic/NEA Program—Mol, Belgium
b. Joint Research Centre of CEC—Ispra, Italy

Source: *Nuclear Waste Management: Program Summary Document, FY 1981*. Assistant Secretary for Nuclear Energy, Office of Nuclear Waste Management, DOE/NE-0008, Draft. U.S. Department of Energy. 1980.

United Kingdom, Germany and Belgium are studying krypton implantation in metal matrices; these countries and France are also making significant progress in developing methods to immobilize tritium. There is universal interest in programs concerned with the monitoring, conditioning, and disposition of tritium-contaminated effluents and wastes.

- The transuranic (TRU) contaminated waste incineration technology in the United Kingdom and Belgium is significant for U.S. programs. A British incinerator and the Belgium slagging pyrolysis incinerator concepts have been used as the design basis for some U.S. work. Wet combustion techniques for combustible wastes are under study in Germany, Japan, Belgium, and the United Kingdom. Moreover, the United States is exchanging acid digestion technology with Germany and the United Kingdom.

The radioactive waste transportation programs of Canada, Japan, the United Kingdom, Sweden, France, and the Federal Republic of Germany are of interest to the U.S., particularly as they relate to the development of technology for packaging design, isolation testing and the assessment of risks. In addition, efforts are underway to establish international safety standards for the transport of radioactive wastes through the International Atomic Energy Agency (IAEA).

Bilateral Agreements

Since 1955, the United States has entered into approximately 115 international agreements, with some 40 countries, to cooperate on issues related to atomic energy. These agreements are primarily related to nuclear research and the development of nuclear power, and include discussions on the use of radioactive substances for medical purposes and the shipment of nuclear materials. Radioactive waste management is an issue for consideration in these agreements, particularly as it relates to the disposal in U.S. based facilities, of spent nuclear fuel ele-

ments generated through U.S. assisted research in foreign nuclear power production.

As shown in Table C-4, the United States has six bilateral agreements and an additional two pending which relate to nuclear waste management. The agreement with Sweden is for a specific cooperative program at their Stripa mine that is part of an OECD/NEA organized program. Activities include field tests and the advancement of techniques used in measuring the movement of fluids through fractures in a granite rock system. The results of these tests will provide useful data to the U.S. for evaluating the use of granite as a terminal storge repository.

Other bilateral agreements provide for the mutual exchange of technical and scientific data, information, and personnel, as well as collaboration on joint projects. The agreements cover waste management aspects of the entire fuel cyle, specifically HLW solidification and packaging, treatment and packaging of intermediate-level wastes and LLW, treatment of TRU waste, trapping and storage of gases, evaluation of alternative disposal concepts, decommissioning of nuclear facilities, operating experience with LLW, transportation of wastes, and retrievable surface storage.

The pending bilateral agreements with France and the European Community provide new initiatives with additional promise for DOE's programs in radioactive waste. In addition, the United States and Brazil have started a university-to-university collaborative research program in support of waste management. The U.S. interest is through New York University, and the Brazil interest is through their Federal University and Catholic University. The planned work is to study the behavior of a natural deposit of heavy elements and to observe what impacts this deposit may have had on the surrounding environment.

Table C-4
Bilateral Agreements

Country	*Date of Current Agreement*	*Principal Subject*
Sweden	September 9, 1980	Radioactive Waste Isolation Stripa Mine Tests
Canada	September 8, 1976 (renewal limited to waste management in progress)**	Radioactive Waste Management and Systems Anaysis of Heavy Water Reactors
Federal Republic of Germany	December 20, 1974 (extended to December 1984 via 1980 Amendment)	Radioactive Waste Management
France	Agreement under negotiation	Nuclear Fuel Cycle
United Kingdom	September 20, 1976 (extended to Sept. 1986)	Fast Breeder Reactors (FBR's)*
Belgium	January 1981	Radioactive Waste Management
Japan	January 31, 1979	Fast Breeder Reactors*
European Community	Agreement (under negotiation)	Waste Management

*These agreements on FBR's include an annex covering cooperation in nuclear waste management. The agreement with Japan also covers FBR fuel reprocessing.

**Currently being re-negotiated. Present MOU extended indefinitely until new MOU is negotiated.

Source: *Nuclear Waste Management: Program Summary Document, FY 1981*. Assistant Secretary for Nuclear Energy, Office of Nuclear Waste Management, DOE/NE-0008, Draft. U.S. Department of Energy. 1980.

Multilateral Agreements

Multilateral cooperation in radioactive waste management takes place under the auspices of several international organizations of which the United States is a member or an observer. The United States participates in advisory groups, working groups, joint meetings, and ad hoc projects through the multilateral agreements.

International Treaty on the Nonproliferation of Nuclear Weapons

In 1970, the United States ratified the International Treaty on the Nonproliferation of Nuclear Weapons, recognizing the common belief that the proliferation of nuclear weapons would seriously increase the potential for nuclear war. Parties to this treaty accepted specified safeguards for the transfer of special nuclear materials and facilities to non-nuclear weapons states for the processing, use, or production of nuclear materials.

International Atomic Energy Agency

The International Atomic Energy Agency (IAEA), established at the United Nations in 1957, was created to expand the world-wide peaceful uses of atomic energy. As stated in Article II of the IAEA charter:

> "The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."

The Agency is authorized to encourage and assist in the development of atomic research by helping to provide needed materials and equipment to participating nations. It also fosters the exchange of scientific and technical information on peaceful uses of atomic energy and encourages the exchange and training of scientists and experts in the atomic energy field. An important function of the Agency is establishing safety standards to protect health and minimize danger to life and property for any materials, equip-

ment, facilities, or information made available by the Agency.

As with the Nuclear Nonproliferation Treaty, a major reason for coordinating with the IAEA lies in the need to control radiactive waste and the potential for acceptance of foreign waste at U.S. based reprocessing facilities. The U.S. realized the importance of such coordination early in its development and thus became a party to the Agency in 1957 (PL 85-177).

The IAEA has published reports, sponsored scientific meetings, and prepared codes of practice on radioactive waste management. Technical guidance is offered to member countries on procedures for establishing limits for release of radioactive material into the environment, and the monitoring of actual releases from nuclear facilities.

An example of activity in the area of radioactive waste is the Advisory Group on Radioactive Waste Disposal into Geological Formations, formed in 1978. The Advisory Group plans to develop guidelines over the next several years for safe underground disposal. The guidelines will address the entire range of currently conceivable options.

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. (The London Dumping Convention, 1972)

The first article of the London Dumping Convention states that:

> "Contracting Parties shall individually and collectively promote the effective control of all sources of pollution of the marine environment, and pledge themselves especially to take all practicable steps to prevent the pollution of the sea by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage or to interfere with other legitimate uses of the sea."

Under the Convention, high-level radioactive wastes are considered unsuitable for dumping at sea and such disposal is prohibited. The responsibility for defining high-level wastes is given to the IAEA as the competent international body in this field. Other radioactive wastes not defined as high-level waste may be disposed of under the Convention by the issuance of special permits by national authorities who should take full account of the recommendations of the competent international body in this field, at present the IAEA. The responsible U.S. authority is EPA. The DOE programs work with and aid EPA in fullfilling their responsibilities.

The Convention encourages international and regional cooperation in both the development of procedures to protect the marine environment in a given geographical area and in the field of monitoring and scientific research. Cooperation between the Contracting Parties to the Convention and Parties to regional agreements to develop harmonized procedure to be followed by the different conventions is one of the key goals.

Organization for Economic Cooperation and Development/Nuclear Energy Agency

The Nuclear Energy Agency (NEA) is the official nuclear power implementation organization of the Organization for Economic Cooperation and Development (OECD). A Steering Committee for Nuclear Energy guides the activities of several coordinating committees. One, the Radioactive Waste Management Committee, together with its several subordinate working groups, is devoted to radioactive waste management. The regular meetings of the Radioactive Waste Management Committee and its working groups have provided a useful catalyst for bilateral activities. Also, there has been considerable discussion of NEA sponsorship for multinational waste projects. These projects include: Cooperative tests at the Stripa Mine, Sweden; ISIRS (International Sorption Information Retrieval System); and studies of waste dumping in the Northeast Atlantic.

Commission of the European Communities

The Commission of the European Communities (CEC) has established a comprehensive program of radioactive waste management technology development to be conducted in various laboratories throughout the European Economic Community (EEC). It parallels the U.S. program and supports a variety of waste conditioning and disposal programs, including surveys of the suitability of disposal in various types of geologic formations. Discussions of a possible bilateral agreement with the United States are in progress. Current work on geologic disposal includes the use of salt formations in the Federal Republic of Germany and the Netherlands, argillaceous formations in Belgium and Italy, and crystalline rock formations in France and the United Kingdom.

The United States has entered into an agreement with the European Atomic Energy Community (EURATOM) to coordinate and cooperate in programs to advance the peaceful application of atomic energy (PL 85-846). This coordination effort includes research and development activities, as well as programs for the purchase, sale, or lease of nuclear materials, equipment, or facilities between the EURATOM communities and the U.S.

International Nuclear Fuel Cycle Evaluation Program

At an October 1977 organizing conference, over 50 nations and 4 international organizations agreed to join the United States in a comprehensive international evaluation of the nuclear fuel cycle. This program was a United States initiative which had the active involvement of the Department of Energy in the working groups. Working Group 6 focused on nuclear fuel storage; Working Group 7 focused on nuclear waste management. The final report of the International Nuclear Fuel Cycle Evaluation (INFCE) Program was issued in March 1980.

APPENDIX D

DEFINITIONS

The major classes of radioactive materials considered in this document are:

- **High-Level Wastes**—These wastes are generated in reprocessing and contain virtually all of the fission products and most of the actinides not separated out during reprocessing. These wastes are being considered for disposal in geologic repositories or by other technical options designed to provide long-term isolation of the wastes from the biosphere.

- **Transuranic Wastes**—These wastes are produced primarily from the reprocessing of defense spent reactor fuels, the fabrication of plutonium to produce nuclear weapons and, if it should occur, plutonium fuel fabrication for use in nuclear power reactors. Transuranic wastes contain low levels of radioactivity but varying amounts of long-lived elements above uranium in the Periodic Table of Elements, mainly plutonium. This waste is currently defined as material containing more than 10 nanocuries of transuranic activity per gram of material.

- **Spent Nuclear Fuel**—These are the irradiated fuel assemblies that are removed from a nuclear reactor after having served their useful life.

- **Uranium Mine and Mill Tailings**—These wastes are the residues from uranium mining and milling operations. They are hazardous because they contain low concentrations of radioactive materials which, although naturally occurring, contain long-lived radionuclides. The tailings, with a consistency similar to sand, are generated in large volumes—about 10 to 15 million tons annually—and are presently stored in waste piles at the site of mining and milling operations.

- **Decontamination and Decommissioning Wastes**—As defense and civilian reactors and other nuclear facilities reach the end of their productive lifetimes, parts of them will have to be handled as either transuranic or low-level wastes, and disposed of accordingly. Decontamination and decommissioning activities will generate significant quantities of wastes in the future.

- **Low-Level Wastes**—Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e(2) of the Atomic Energy Act of 1954. Low-level wastes are generated in almost all activities involving radioactive materials and are presently being disposed of by shallow land burial.

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APPENDIX E

ACRONYMS

AEC	Atomic Energy Commission; most of its functions have been assumed by DOE and NRC
AGNS	Allied Gulf Nuclear Services
AL	Albuquerque Operations, DOE
ANL	Argonne National Laboratory, Argonne, IL
ASNE	Assistant Secretary for Nuclear Energy, DOE
BNFP	Barnwell Nuclear Fuel Plant
BWR	Boiling Water Reactor
CFR	Code of Federal Regulations
CH	Chicago Operations, DOE
CRBRP	Clinch River Breeder Reactor Plant
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DRP	Demonstration Reprocessing Plant
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
GESMO	Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors,
GJ	Grand Junction Office, DOE
HLW	High-Level Waste
HLLW	High-Level Liquid Waste
HQ	Headquarters, DOE, Washington, DC
ID	Idaho Operations, DOE
IET	Integrated Equipment Test Facility
INEL	Idaho National Engineering Laboratory—near Idaho Falls, ID
INFCE	International Nuclear Fuel Cycle Evaluation
LASL	Los Alamos Scientific Laboratory, Los Alamos, NM (now called LANL)
LLW	Low-Level Waste
LMFBR	Liquid Metal Fast Breeder Reactor
LWR	Light Water Reactor
MED/AEC	Manhattan Engineering District/Atomic Energy Commission
NEPA	National Environmental Policy Act of 1969
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
NWTS	National Waste Terminal Storage, located at INEL
NV	Nevada Operations, DOE
OR	Oak Ridge Operations, DOE
ORNL	Oak Ridge National Laboratory, Oak Ridge, TN
PNL	Pacific Northwest Laboratory, Richland, WA
PWR	Pressurized Water Reactor
R&D	Research and Development
RL	Richland Operations, DOE
SRL	Savannah River Laboratory, Aiken, SC
P	Savannah River Plant, Aiken, SC
TEF	Test and Evaluation Facility
TRU	Transuranic Waste
TVA	Tennessee Valley Authority
USGS	U.S. Geological Survey, DOI
UNI	United Nuclear Industries
UMTRAP	Uranium Mill Tailings Remedial Action Program
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978